THE IMPACT OF IMPLEMENTING HERITAGE ELEMENTS IN CONTEMPORARY BUILDINGS IN THE UNITED ARAB EMIRATES

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A thesis submitted in partial fulfilment of the requirements of the University of Wolverhampton for the degree of DOCTOR OF PHILOSOPHY

February 2019

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Abstract

Due to the rapid growth and development which occurred during the last century the United Arab Emirates witnessed dramatic changes after oil discovery and the economic boom. This affected the building and construction sector that formed the urban fabric of the country.

The four fundamental architectural heritage elements of the UAE are the mashrabiya, the wind tower, the courtyard and the broken entrance, these essential architectural heritage elements were efficiently implemented in traditional buildings. In the context of the contemporary; preservation challenges are experienced particularly when foreign architectural design is seen to be increasing dominating the cityscape and the architectural heritage elements are being misused neglecting their functionalities. This research aims to analyze and compare the efficiency of architectural heritage elements in the contemporary buildings and seeks to gather thorough rationale and logical interpretation in heritage elements.

In order to investigate these four architectural heritage elements further, 'case study 'methodology has been used to inspect the performance of four local contemporary buildings and a comparison technique (Comparative Analysis) was conducted to better understand the outcomes of the analysis. The case study research is being preferable as a strategy due to the exploratory nature of the research and it essentially responds to research questions that seek explanation rather than experimentation.

This research diverse from the usual traditional and contemporary comparison of heritage elements and focuses on comparing their reliability and functionality when addressed in contemporary buildings. It asserts that preservation must be in mind as a pre-requisite towards interpretation of heritage elements and ensures that currently more advanced technologies can be fully exploited to embrace traditional elements to achieve development requirements.

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Acknowledgements

First of all, thank you to almighty Allah for helping me with this work. It has been an enjoyable, long journey. A couple of years ago, it seemed there was a distant possibility of completing this research but here I am submitting this research which has been dear to my heart.

This work would have not been possible without the guidance, patience and right direction of my supervisor team, Prof. Arif and Dr Shuba. My special thanks go to my academic advisor, Dr Fineer (Culture Office, London) for all his encouragements and guidance during various stages of this work.

I would sincerely acknowledge His Highness Shaikh Sultan Muhammed Al Qassimi, Ruler of Sharjah, member of federal supreme council of the United Arab Emirates, the person who gave me the opportunity to start this study.

I am extremely grateful to the Former Minister of Higher Education and Scientific Research, His Highness Sheikh Nahyan Bin Mubarak Al Nahyan for providing me with the utmost support to kickstart my study.

Special heartfelt thanks to my mother, brothers and sister for the continuing encouragements to complete my study.

List of Abbreviations

ADIC	Abu Dhabi investment council
ADNOC	Abu Dhabi national oil
AIC	American Institute for Conservation
APTI	Association for preservation Technology International
ASG	Architectural Specialty Group
CIPP	Context, Input, Process and Product
D	Developed
ETFE	Ethylene tetra fluoroethylene
F	Functional
GRC	Glass reinforced concrete
ICOMOS	International Council On Monuments and Sites
IHBC	Institute of Historical Building Conservation
IRENA	International Renewable Energy Agency
LPCD	Law for the Protection of Cultural Properties
MIST	Masdar Institution of Science and Technology
NF	Not Functional
PRT	Personal rapid transit
PV	Photovoltaic
SOM	Adrian Smith, Owings and Marill
SPAB	Society for the Protection of Ancient Building
ST	Street
T	Traditional
UAE	United Arab Emirates
UNESCO	United nations Educational, Scientific and Cultural Organization
WATG	Wimberley ,Allison, Tong and Goo

Chapter 1

1.1 Introduction

Architectural heritage constitutes an integral part of any nation's identity, culture and pride. Heritage is seen as one of the "usual suspects" of local grass-roots opposition to urban development, while development pressures are perceived as endangering heritage (Veldpaus, 2015).

Historically, the UAE's architecture was designed and built to respond effectively and dynamically to the population, environmental, social and religious requirements. Contemporary architects incorporate various elements of UAE architectural history; using them to configure elements to fit into design schemes. This approach only transfers elements of form and strips them of their historical context and values. It has created an incorrectly spelt architectural vocabulary that is detached from its historical context; ill-fitting into present design concepts, and therefore it will be misinterpreted by future architects. It is important to preserve elements of heritage values in these built environments for continuity of the local identity and culture. Many research studies, such as Benkari (2013), have criticized the present built environment of the Islamic/Arabic world and highlighted problems in the United Arab Emirates' present built environment.

These problems can be divided into three categories:

- Firstly, the adoption and use of foreign architectural style and its effect on the UAE's architecture. Some studies argue that modern architecture is imported and has no connection with the UAE's architecture that is based on the use of certain visual features (e.g. arches and colonnades) and certain design criteria, such as emphasis on privacy and respecting the rights of users in the UAE. Which is mostly absent in modem architecture (Al-Zubaidi, 2007).

- Secondly, contemporary architecture has a poor link with the UAE's values (e.g. socio-cultural) and does not respond effectively to people's needs and inspirations (e.g. design, organizations and structures of Islamic society) (Abedi & Soltanzade, 2014).
- Thirdly, there is an over-misuse of heritage architectural elements and misallocation of them within modern structures. For the past half-century, this copy and paste or image cloning became a passive phenomenon in the UAE, neglecting the environmental needs and the adaptation required to face the weather conditions (El Amrousi & Shaker, 2013).

The modern architecture in the UAE does not hold the same values as the traditional architecture and it is detached from its historical, social and cultural context, which can result in many misleading meanings and which may be misinterpreted by future architects to generate designs which are uncomfortable for the users.

Recently there has been a call for returning to the identity of the architectural forms that are in harmony with culture and human environment (Bahnassi & Haddad, 2003).

This research argues that the architects should comprehend not only the hidden values of heritage elements but also the efficiency of traditional architectural elements. By doing so, the modern architecture is being able to correctly perceive and read these elements, thus incorporating it successfully into the initial design stages.

This research proposes a conceptual model for analyzing and interpreting a vocabulary of architectural heritage and incorporating it into contemporary architectural designs.

1.2 The Problem

Public participation and awareness in the UAE is a relatively contemporary idea that has gained relevance in different fields, such as urban planning and heritage preservation, in the last few decades. However, it is yet to be fully explored within urban preservation.

HH Sheikh Mohammed bin Zayed bin Sultan Al-Nahyan, the Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE's Armed Forces, said in 2016:

"Cultural heritage is threatened now, more than any time before, by conflict, terrorism and the exponential growth of illicit trafficking, despite the fact that such activities are condemned by all religions, international conventions and value systems. Preserving this cultural heritage is therefore a responsibility shared by all of us."

Unfortunately, preservation has not always been the priority for local authorities in the UAE. Even when there have been good intentions in local architects, often these ideas have been applied either with poor designs, or with lack of appropriate preservation and implementation of heritage elements within the contemporary architecture.

Mohamad Khodr Al-Dah, Senior Director of Dubai Land Department, said in 2017:

"We see, in our everyday work as structural engineers, a lot of old, historical, and cultural buildings [being demolished] to make way for newer buildings," he told Construction Week. *"We are demolishing a small villa to build a four-storey building. And then, before you know it, we're demolishing the four-storey building to construct a 20-storey tower."*

As well as the locals' nostalgia for the traditional architecture, in addition to the rapid development that resulted in neglecting the local signature of the buildings, which led to the excessive application of the heritage elements in locations where they perform neither any aesthetic benefits nor thermal advantages.

The ill-usage and the poor recruiting of the heritage elements impacted the importance of the structures and the functionality of these elements.

Another common issue is that the variety of communities actively implements their traditions and knowledge in contemporary architecture which often conflict with the local process of heritage elements preservation.

The implementation of heritage elements has been in practice over centuries but has not been studied in detail to take their place in the spectrum of the Emiratis' buildings.

1.3 Research Aims

This research aims to investigate and assess interventions made to use architectural heritage elements in contemporary buildings in the UAE.

1.4 Research Objectives

To systematically address the relevant issues of the study area, this research has the following objectives:

- Identification of heritage elements in Emirati architecture and how it is integrated.
- To analyze the traditional heritage elements within the contemporary buildings in terms of their functionality, developed techniques validity, thermal performance and social sustainability.
- To design a conceptual framework that integrates architectural heritage elements with contemporary architectural designs and construction developments.
- To determine the advantages and disadvantages of using the heritage elements within the contemporary buildings.
- To formulate a set of recommendations and guidelines to improve the implementation of architectural heritage elements in the UAE

1.5 Research Questions

Architectural heritage elements and its place in contemporary design of the UAE is the focal point of this research. On this basis the relevant questions are as follows:

- What are the Emirati heritage elements and how are they used in contemporary buildings?
- How efficient can developed heritage elements be and the methods that have been taken in consideration to operate these elements?
- How did examining the case studies affect the level of understanding of the implementation of heritage elements performance in contemporary buildings?
- How important the heritage elements are with regard to the buildings' performance and the country's cultural and historical print?
- What regulations could be implemented in the country to enhance the efficiency of implementing the architectural heritage elements?

1.6 Unit of Analysis

Researches must be conducted depending on questions related to their unit of analysis and the related idea of the unit of observation. Unit of analysis helps the researcher define what is being studied as well as what aspects the research is oriented upon. Each unit of analysis and its related questions and propositions would call for a slightly different research design and data collection strategy (Drucker, 1986).

The selection of the appropriate unit of analysis helps direct the research to the suitable path that fulfills the research questions and generates a valuable set of recommendations to help solve the research problem.

In this research, data is collected, analyzed and compared for contemporary buildings in the UAE (the case studies) which are considered to be the individual that will be examined to compare their degree of efficiency in terms of implementing the architectural heritage elements.

1.7 Importance of this Research

Since independence, 2 December, 1971, the United Arab Emirates has witnessed huge economic changes due to oil and gas discovery: this has been used in the building of a modern infrastructure. Its population has grown significantly, which has all happened against a backdrop of social stability (Al Abed & Hellyer, 2001). This has brought economic prosperity, drastic income growth, and transformation of lifestyles. Many social values and cultural standards were affected in undesirable ways as well as architecture's rapid development of the country. The UAE is not the largest Gulf state, nor does it have the most resources, yet it has become a model for the region and the Arab world due to the huge shift in income and development.

The accelerating steps that have taken place have made the country a focal point for many countries, especially in the Arab world. Much has been written about the UAE by locals and visitors in different aspects, such as: economic prosperity, luxurious lifestyle, well planned cities, pioneering buildings and leading development policies.

However, there was a lack of in-depth research into architecture, especially contemporary architecture, in addition to misusing the heritage elements in buildings which put the architectural identity of the country on the point of vanishing.

Contemporary architecture is fascinating regarding the way people tried to compromise between their traditional and social values on one hand and the modern lifestyle on the other. The high density has specific challenges; fast increasing populations, decaying social fabric, loss of

traditional crafts, rising land values leading to even higher developments, poor or no conservation policies, leaving some traditional architecture vulnerable.

Often, limited preservation efforts have little or no connection or consultation with the local community in the decision-making process (Briggs, 1974). This has led to ignoring local preservation policy-making. Limited organized preservation efforts have often proved inadequate and even lead to disturbing the heritage they are trying to preserve.

Alexander Tzonis has made contributions to architectural theory, history, and design knowledge, bringing together scientific and humanistic approaches in a rare synthesis. Tzonis focuses on the cognitive underpinnings of the classical design rule system as well as its historical origins. Designers, whether solving problems or exploring possibilities, should think critically. They should overcome biases favouring imported or local choices through questioning and reflections, considering the specifics of the actual situation.

Also, Kenneth Frampton recalls: *"how to become modern and to return to sources, how to revive an old dormant civilization and take part in universal civilization"*. According to Frampton's proposal, critical regionalism should adopt modern architecture critically for its universal progressive qualities, but at the same time value should be placed on the geographical context of the building.

Architectural theory is important for its own sake, but it is also significant because of the centrality of buildings to human experience. Buildings shelter and shape daily lives; people in return attempt to craft their environments to tell stories about the way in which they would like to be perceived and understood.

Preservation of architectural heritage becomes a historical and humanitarian responsibility, which contributes to keeping past landmarks in order to be seen in the future. Man, with his historical determinism of the past, present and future, has always tried to record the present and preserve his past to see his future.

"***He who doesn't know his past can not make the best of his present and future for it is from the past that we learn" HH Sheikh Zayed.***

Architectural heritage reflects the cultural identity of humans; with the continuation of cultural innovation of different civilizations into the third world, the preservation of the cultural identity through the preservation of the architectural heritage has now become a central aim.

The findings from this research can make a potentially important contribution to the theory, by filling the knowledge gap of the weak heritage elements placements in the contemporary buildings of the UAE.

1.8 Scope of Research

This research includes three levels of investigation:

- The first level focuses on the historical background, which aims to define both the constant and changing factors and their influence on traditional architecture in the aspects of socio-economic, environmental and culture.

- The second level investigates the current situation in contemporary architecture and the efficiency of implementing architectural heritage elements in contemporary buildings of the UAE.

- The third level investigates the attempts and need for developed approaches and suggestions for using heritage elements in contemporary architecture of the UAE (Figure 1.1) shows a structural diagram of these Levels:

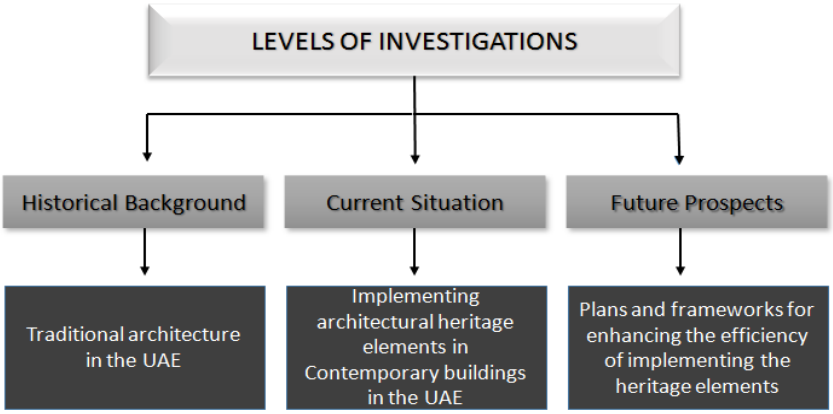

Figure 1.1: The levels of investigation

To build a clear basis for operating this research and answering the questions, this requires a review of the relevant literature on heritage elements within architecture and the built environment, traditional architecture and contemporary architecture in the UAE.

1.9 Research Methodology

Architecture and the built environment reflect many social and cultural aspects of the society in which it is found. The impact of architectural heritage elements is best observed when a society is undergoing major changes. The impact of heritage element upon what is built can be seen from several standpoints:

- By comparative analysis of the ranges of buildings.
- By considering typological variations of building types within the UAE.
- By examining how the built environment within a society varies over time.
- By noting what is built within a society by subcultures.
- By comparing the efficiency of the heritage elements in different buildings in the UAE.

The strategy of this research is to examine the development of what is being built within a society over a period of time and its relationship to environmental and cultural aspects. This research focuses on architectural heritage elements via a comparison between the traditional and developed heritage elements within the built environment and their degree of functionality.

This research methodology will carry out qualitative analysis for contemporary structures that have embraced traditional architectural elements of the UAE. This research relies on the integration of both theoretical and empirical investigations, which are divided into two levels:

The **theoretical level**: A documentary analysis of data is used. Documentary analysis means content analysis of the relevant documents that include books, journals, magazines, archival data and observations. The documentary analysis aims to investigate the context of the research problem to build a basis for the identification of features in heritage elements that will be determined through contemporary architecture.

The **empirical level** involves comparative analysis of four contemporary case study buildings. Through the comparative analysis, some techniques will be employed to collect primary data, such as systematic analysis of the architectural drawings and direct observation.

A "Loop" best shows this theoretical presentation of architectural design influences in the United Arab Emirates. The wheel shows a confluence and integrative congregation of concepts including the elements of heritage. It also includes new buildings, architectural concepts brought in by foreign designers and the future blend of Emirati culture, heritage and tradition as reflected in its architectural structures and designs. The loop shows the interplay of this study on Emirati heritage and architecture. The components of the loop are as shown in Figure 1.2.

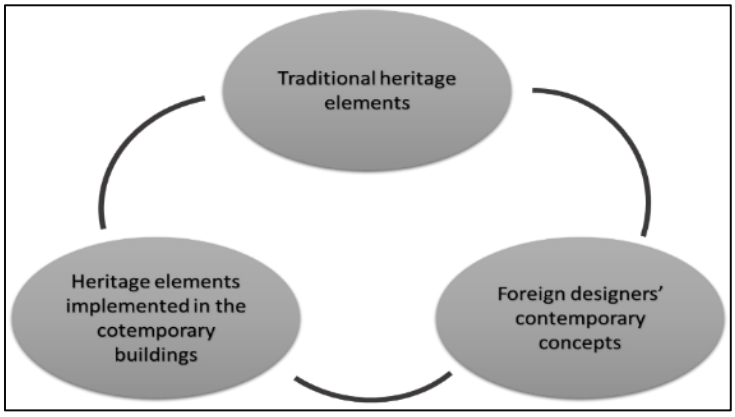

Figure 1.2: The interplay loop of the UAE's architecture

1.10 Conceptual Work Progress

Present realities could become a potential challenge for the next generation and could threaten the cultural and architectural perceptions of the development in the Emirates; due to the rapid adoption of foreign architecture without any means of adopting the heritage elements of traditional Emirati architecture. This has prompted the government, concerned sectors of the UAE, decision-makers and policy-makers to find ways to understand this trend and put in place recommendations that will answer the nagging demands of development and preservation. This research will assess this situation in a formal and analytic study and make recommendations to investigate and assess, to present a vivid perspective to help evaluate current architectural practices. Ideally, there will then be a process of infusing and integrating the cultural and heritage elements into the architectural skyline. For this purpose of evaluation, the CIPP model will be used.

This is a systematic approach that will dissect the interplay of context, input, process and product, resulting in a fair and balanced analysis of the current condition. Through this model, the research will view the following: 1. Context: is embodied by the architectural concept in contemporary architecture which starts the process. 2. Input: is represented by the prevailing buildings and their designs. 3. Process: is the actual transformation in the structure by infusing or integrating the elements of heritage and culture into fresh designs. 4. Product: is represented by the new building design resulting both from the infusion and fusion of the elements of Emirati heritage and culture via new concepts brought in by foreign architects, engineers and designers within the construction industry.

These contributions are then made as the basis of culturally acceptable development recommendations of design changes to architectural practices.

1.11 Structure of the Research

Chapter One: Introduction. This chapter is dedicated to establishing the pillars of this research. It carries a thorough discussion of the problems as well as the aims and objectives of this research. It defines the scope and layout of the very foundation of the research methodology that shall be adopted in this research.

Chapter Two: Defining the historical origins of architectural elements. This chapter discusses the factors that might affect the architectural elements of the country, such as geography, climate and population. The history of Emirati architecture will also be discussed in a multi-perspective manner; how architecture has evolved in the country and the needs of the Emiratis. Also, there will be a definition of traditional heritage elements so as to determine what traditional elements are to be examined.

Chapter Three: Research Methodology. This chapter discusses the methodology which this research adheres to. In this research, the case study method is used.

Chapter Four: Discussion. This chapter is a discussion of the case studies, which are as follows: the Abu Dhabi Central Market; Al Bahr Towers, Abu Dhabi; Masdar Institute Abu Dhabi; and the Central Souq Sharjah. The criteria of assessment are defined and discussed for their suitability and will explain different result insights into each chosen study.

Chapter Five: Conclusions and Recommendations. This chapter will evolve answers for the empirical questions of this research, the outputs and the set of recommendations to enhance the problem discussed.

In order to better understand the relation between the objectives and raised questions of this research, a data flow table was designed to assign the related information for each objective in the appropriate chapter (Table 1.1).

Table 1.1: Research objectives' organizing table

Objectives	Questions	Addressed in Chapter:
• Identification of heritage elements in Emirati architecture and how it is integrated.	What are the Emirati heritage elements and how are they used in contemporary buildings?	Chapter 2
• To analyze the traditional heritage elements within the contemporary buildings in terms of their functionality, developed techniques validity, thermal performance and social sustainability.	How efficient can developed heritage elements be and the methods that have been taken into consideration to operate these elements?	Chapter 2 Chapter 4
• To design a conceptual framework that integrates architectural heritage elements with contemporary architectural designs and construction developments.	How did examining the case studies affect the level of understanding of the implementation of heritage elements performance in contemporary buildings?	Chapter 3 Chapter 4

• To determine the advantages and disadvantages of using the heritage elements within contemporary buildings.	How important are the heritage elements with regard to the buildings' performance and the country's cultural and historical print?	Chapter 4
• To formulate a set of recommendations and guidelines to improve the implementation of architectural heritage elements in the UAE.	What regulations could be implemented in the country to enhance the efficiency of implementing the architectural heritage elements?	Chapter 5

Chapter 2

Defining the Historical Origins of Architectural Elements

2.1 Introduction

This chapter illustrates the historical architectural background of the United Arab Emirates and focuses on traditional implementation of heritage elements in buildings and the development that occurred to change the path of those elements' impact.

It also intensifies the importance of preserving the heritage identity of the country and maintaining the Emirati architecture for future generations to grow up with pertinence to the country.

2.1.1 UAE: General View

As a federation, the United Arab Emirates was established in 1971, consisting of seven emirates. The federation is composed of Abu Dhabi (the capital), Dubai, Sharjah, Ajman, Umm al Quwain, Ras al-Khaimah and Fujairah. It is not only considered as the fourth largest producer of oil, but it is noteworthy in this research to distinguish it as one of the richest countries per capita and being the modern commercial capital of the Middle East (uae.gov.ae, 2014).

2.1.2 Geography and Location

The UAE is formerly known as the Trucial States, consisting of the seven emirates located along the coast of the Arabian Gulf, which subsequently formed the United Arab Emirates (UAE). In the northwest (Figure 2.1), the UAE is bordered by Saudi Arabia, and on the west, south, east and northeast by Oman. Along the southern shore of the Arabian Gulf, the UAE stretches for more than 650 kilometres. Most of the coasts are saltpans that often extend inland. Dubai has the largest natural harbour, though there are numerous ports being dredged, such as in Abu Dhabi and Sharjah.

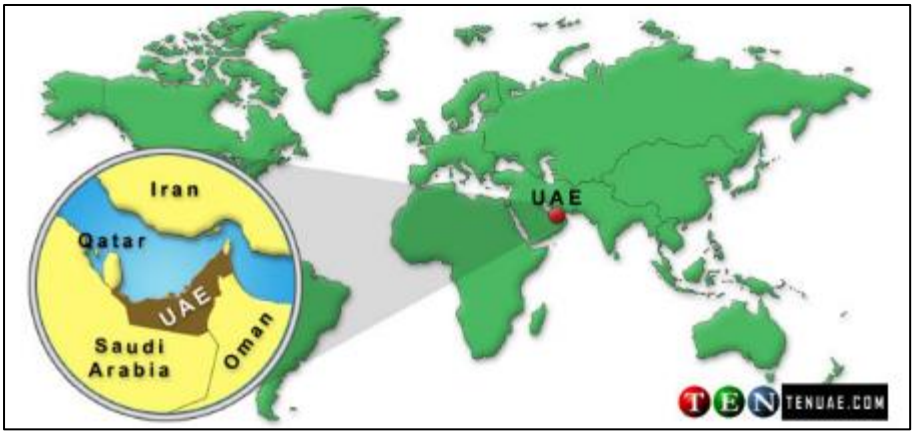

Figure 2.1: UAE Location & Geography
Source: Ten guide upon, guide.theemiratesnetwork.com

The UAE has a total land area of 77,000 square kilometres. Abu Dhabi, being the largest emirate, accounts for 87% of the total area of the country (67,340 sq. km) and stretches along the coast of the Arabian Gulf. The other six emirates are collectively clustered along the Musandam Peninsula, which separates the Arab Gulf from the Gulf of Oman and these emirates are: Dubai, Sharjah, Ajman, Umm al-Quwain, Ras al-Khaimah and Fujairah; these emirates divide the Arab Gulf and the Gulf of Oman. The smallest emirate is Ajman, measuring 259 square kilometres (Figure 2.2).

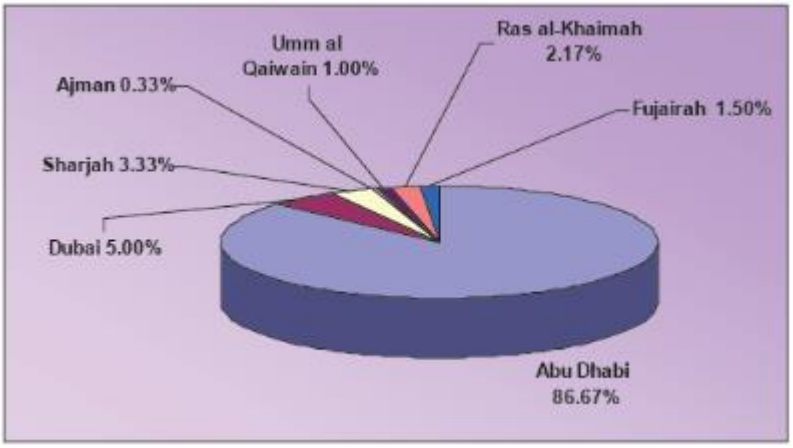

Figure 2.2: Emirates Area Percentage in the UAE
Source: SKAK based on UAE Yearbook, 2006

The country is divided geographically into coastal, mountains and desert zones. More than 75% of the topography is desert and sand dunes, of the area which is north of the Saudi desert, from

Kalba in the south to Khorfakan in the north is the stretch of the Eastern coast, while the western coastal stretch commences 1km south of Sha'am and gradually widens towards the north with several islands and coral reefs (Mahgoub, 1997).

2.1.3 UAE: Climate

The UAE lies between 22°50' and 26° along north latitude and between 51° and 56°25' east longitude, signifying that it is located in the sub-tropics where the Cancer latitude (23º5") crosses over the southern third part. During the summer, it is exposed to the vertical sun, meaning that spring and autumn are extended. In this research, it is crucial to establish that the climate of the UAE is hot, humid and dry. These weather conditions must be taken into consideration when designing buildings. The lack of vegetation and clear skies increases the effect of heat, not only during the day but also into the evening, particularly during summer when the days can be as long as 16 hours. Due to evaporation of the sea, humidity is high from the almost closed Arabian Gulf, which can be as high as 65%, making the temperature unbearable (Figure 2.3).

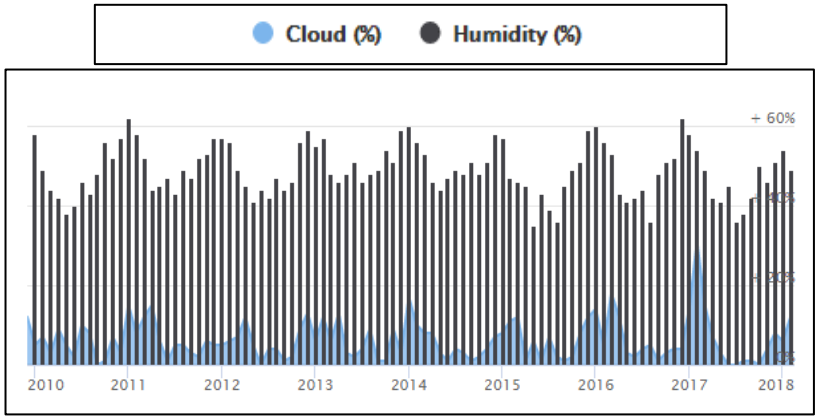

Figure 2.3: UAE yearly humidity Average
Source: worldweatheronline, 2018

July and August are the hottest months, when an average maximum temperature can reach more than 48°C in the coastal areas. In the mountains of Al Hajar and Al Gharbi, the temperature is cooler due to the high altitude. During January and February, the average minimum temperature is between 13°C and 16°C (Figure 2.4).

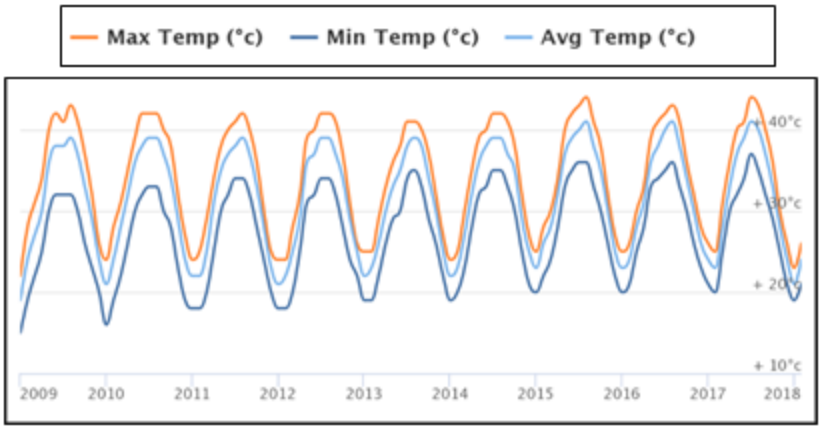

Figure 2.4: UAE yearly Temperature Average
Source: worldweatheronline, 2018

A humid southeastern wind is experienced during late summer, called the Sharqi or the eastern wind, which makes the coastal region very unpleasant. In the coastal area, the average annual rainfall is fewer than 120mm but in some areas in the mountains, the annual rainfall can reach up to 350mm. The UAE is occasionally prone to dust storms, which greatly hinder visibility.

2.1.4 Historical Overview

Civilization has flourished in the UAE, despite its harsh climate, since the earliest times. There is archeological evidence as far back as 5000 years ago (Heard-Bey, 2004) that some communities lived in the area. In the 7th century, Islam spread throughout the UAE. To protect the India trade from raiders, early British expeditions at Ras al-Khaimah led campaigns against their headquarters and other harbours along the cost in 1819. A general peace treaty was signed in 1820 by the British and principal sheiks of the coast. Another treaty was signed in 1853 with the United Kingdom under which the sheiks of the Trucial Sheikhdoms had agreed a maritime truce. The United Kingdom enforced the treaty, and disputes among the sheikhs were referred to the British for settlement. In reaction to the ambitions of other European countries wanting to take over these lands, the United Kingdom and the Trucial States established closer bonds in a treaty that was signed in 1892, similar to ones with other principalities of the Gulf (The Columbia Electronic Encyclopedia, 2006).

After World War II, the British granted an internal independence to the sheikhdoms. In 1968 discussions began to start regarding creating a federation, when the United Kingdom announced that it intended to withdraw from the Arabian Gulf by 1971 to end the treaty relationship with the Trucial States. The Trucial States became independent when the treaty expired on 1 December 1971. On 2 December 1971, six Trucial States entered into a union called the United Arab Emirates and in early 1972, the seventh emirate, Ras al-Khaimah, joined the federation. Since its federation in 1971, the UAE has witnessed a dramatic growth by putting into good use the revenues it earned from both oil and gas production in the building of infrastructures coinciding with the rapid growth of its population (Al Abed & Hellyer, 2001).

2.1.5 UAE Society and Population

Population is concentrated primarily in various cities along both coasts. Until the exploitation of oil, the population had been economically depressed due to the harsh environment and marginal economic conditions. There were 80,000 to 95,000 inhabitants, according to estimates. There were considerable shifts within the territories caused by the economic changes and political conditions. In 1963, Abu Dhabi onshore oil exports commenced, opening the floodgates of wealth and a demand for foreign labour. The census of 1968 stated that there were 180,226 inhabitants. A population boom in the 1970s and 80s was fuelled by the demand for labour and expertise (Figure 2.5).

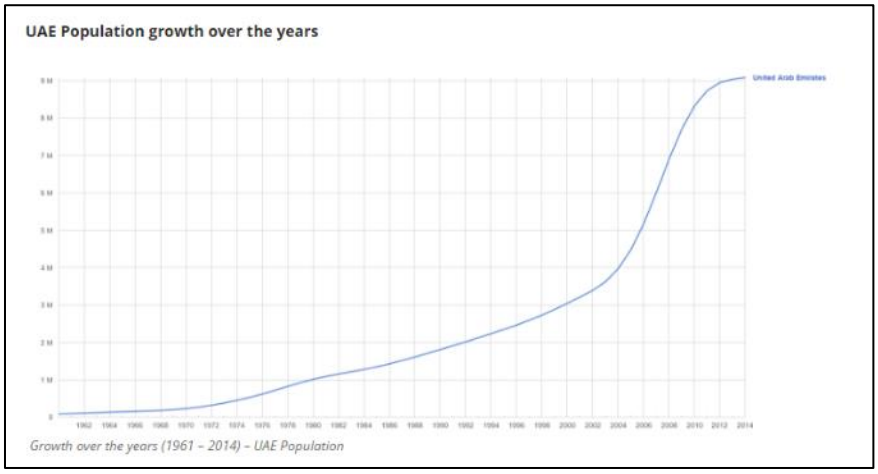

Figure 2.5: Population growth in the UAE
Source: abudhabi2.com, 2016

Abu Dhabi, Dubai and Sharjah are the three most populous emirates, accounting for 84% of the total population. The population of the remaining four emirates is 16%. With more than 90% of the people living in cities, the population of the UAE is predominantly urban (Table 2.1).

Emirate	2010	2009	2008	2007	2006
Abu Dhabi	404,546	398,148	385,655	373,584	361,636
Dubai	168,029	164,448	157,514	151,127	144,296
Sharjah	153,365	151,506	147,855	144,319	141,281
Ajman	42,186	41,852	41,192	40,555	39,897
Umm Al-Quwain	17,482	17,296	16,930	16,576	16,238
Ras Al-Khaimah	97,529	96,329	93,973	91,777	89,785
Fujairah	64,860	63,802	61,738	59,803	58,031
Total	**947,997**	**933,381**	**904,857**	**877,741**	**851,164**

Table 2.1: Distribution of Population in the UAE
Source: The national census center 2006-2010

The officially estimated population of the country in mid-1991 was 1.9 million, which was projected to increase to 2.94 million ten years later in 2001 with a 6.5% yearly growth rate, though it was seen that it would slow down by 2.9% in the year 2005, when the population was estimated to reach 3.48 million according to The World Factbook (2006).

The 2005 census, which was released in July 2006, shows that the total population of the UAE had increased to 4,104,695 with a growth rate of 1.52%.

According to the UAE's latest census, done in 2012, the population was estimated to be 9 million, and it was expected to reach 11 million by 2022 (Figure 2.6).

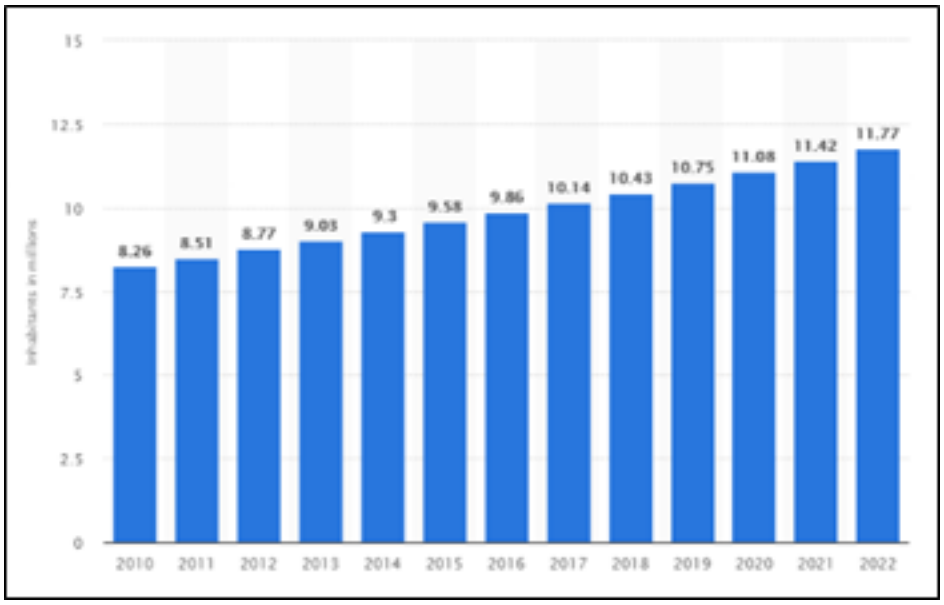

Figure 2.6: UAE Population Development
Source: The National Census Center, 2016

The UAE's demographic population is unbalanced between nationals and expatriate residents; less than one-fifth of the population are UAE nationals. Since 1968, the number of foreigners has increased dramatically, comprising 36% of the total population. In 1975, it increased to 70% of the total and subsequently increased to 80% in 1980 and 88% in 1985 (Figure2.7).

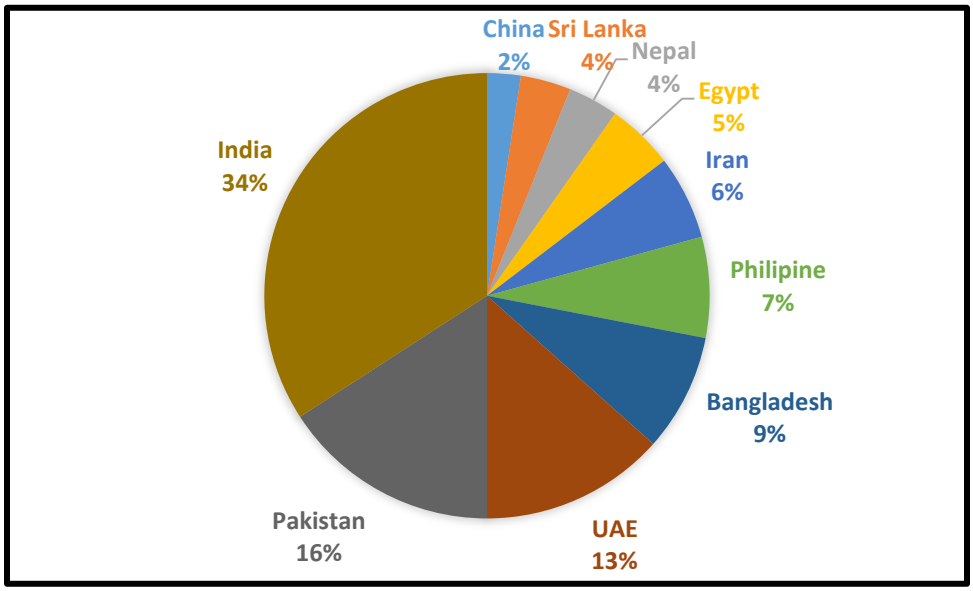

Figure 2.7: Ethnic grouping percentage in the UAE society
Source: The National Census Center, 2016

2.2 History of UAE Architecture

2.2.1 1900 – 1930: The Traditional Architecture

Urban settlements in the United Arab Emirates were fragmented depending on which fundamental resources were available, as well as the secure vantage points.

Hence, its main cities such as Abu Dhabi, Dubai and Sharjah were consequently established on land where there is access towards a creek. Sometimes they inhabited islands, such as in Abu Dhabi (Figure 2.8) where it can be reached when the waters are shallow because of the low tide (Vernacular Architecture in UAE, 2010).

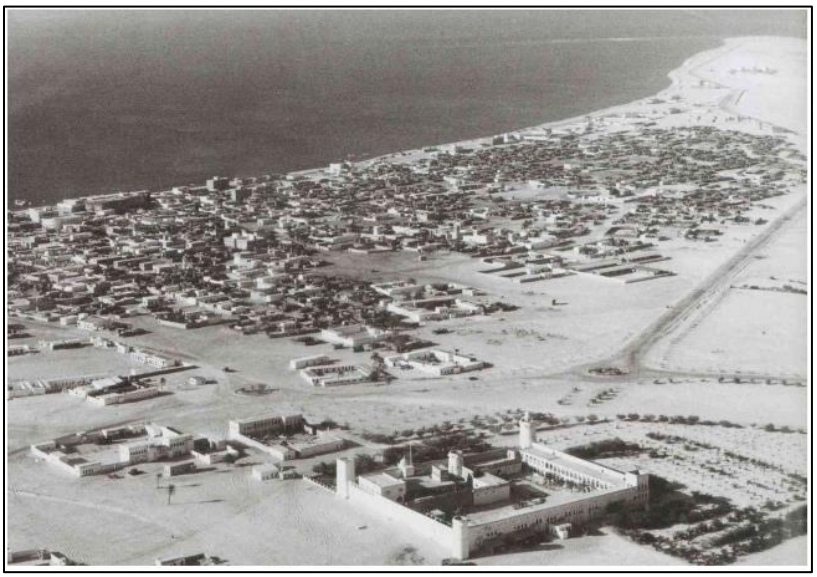

Figure 2.8: Abu Dhabi in the 19th century
Source: Istp2.ae, 2014

The inhabitants of the UAE, before the discovery of oil, lived a simple and traditional life, relying on date crops, fishing and pearl trading as the major sources of income. The social and cultural values of the region are reflected by the traditional architecture; designed to respond to the hostile natural environment with innovative solutions towards quality of life through their dwellings.

These main three cities gradually developed into bustling commercial centres, where people of various traditions and cultures from different places settled, which led to creating unique communities. Architecture in the first forty years of the last century remained traditional due to the fact that life was simple, where there was a shortage of resources and little motivation to change.

The traditional architecture in the UAE, and it being a multicultural society, had an impact on the style of architecture by its various nationalities. Generally, its architecture has been influenced by Islam (Bukhash, 2000). Until the late 1930s, the buildings in the UAE can be classified as defensive, souqs, residential, religious and public buildings. The majority of settlements and buildings were built in the last two centuries.

2.2.1.1 Defensive Buildings

Castles, watchtowers and forts were performing as defensive buildings and were basic predominant features. In the 18th and 19th centuries, when cities were small and fragmented, they had to be secured and protected against enemies and dangers. Defensive buildings were built using coral stones as strong and durable materials which were accessible readily in the country.

The main structures were the forts, which people built their houses nearby. The fort was integrated with the residence and court of the ruler, which eventually became a symbol of status and power (Bukhash, 2000). Forts became shelters when inhabitants were under attack (Maitra & Al-Hajji, 2001) (Figure 2.9).

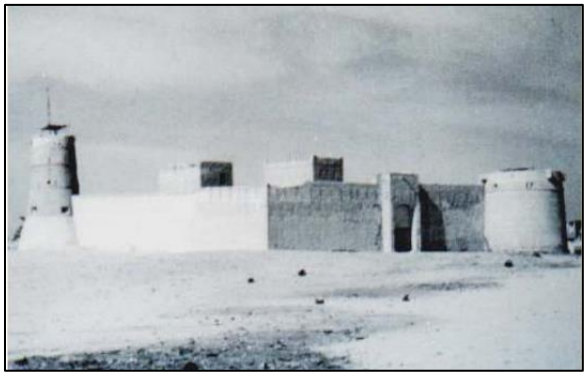

Figure 2.9: Al Faheidi fort, built 1799
Source: Bukhash, 2000

Forts were established in each city and the majority of them were built in the 18th, 19th and 20th centuries. In 1903, Sheikh Saed Bin Hamad Al-Qasimi established the Al Gail Fort in the Emirate of Sharjah on the eastern coast. In 1898, the Al-Jahili Fort was built by Sheikz Zayed Bin Khalifa Al-Nahyan and in 1936-1939 the Qasr Al Husin Fort in Abu Dhabi was expanded by Sheikh Zayed bin Sultan Al-Nahyan (Bukhash, 2000).

2.2.1.2 Residential Buildings

Most of UAE's cities are composed of residential buildings. There were two types in urban coastal cities: for the poor, palm leaf houses, the 'arish' and for the rich, large courtyard houses made from coral stones. Most of the houses of the 19th century were one-storey only (
Figure 2.10).

Figure 2.10: Traditional housing style in the 19th century
Source: Gulf News, 2018

However, at the beginning of the 20th century, when coastal cities opened their doors to international traders, there were many merchants who settled in the city (Bukhash, 2000). To provide privacy and modify the harsh environment for inhabitants, all private spaces opened towards an internal opened courtyard. High elevations were often solid and massive, most

particularly on the ground level. On the first floor, small openings appeared in repetitive sequence; the vertical elements were the wind towers that provided ventilation for internal spaces within the house. To create shadows, houses were arranged close to each other in an organic pattern, creating shaded alleys.

This architecture allowed for protection against the harsh climate by creating different pressure points between the sunny and shaded spaces, causing natural air movement in the hot and humid climate of the coastal regions. During the first half of the 20th century, building houses in the traditional way was continued until modern building materials began to be used in domestic buildings during the 1950s, such as concrete.

2.2.1.3 Market (Souqs)

The economic heart of Emirati cities was and is the souqs, particularly along the coasts (Figure 2.11). They consisted of different shops arranged in a linear manner near to residential areas with particular routes perpendicular to the main stream of the souq (Dubai Municipality, 2004)

Figure 2.11: The old Dubai spices market (Souq)
Source: Juma'a Al Majid Centre for Culture & Heritage, 2005

In Dubai and Sharjah, some of the old souqs are still important in the economic life of the city. Due to the simple life of inhabitants prior to the discovery of oil, public buildings such as the schools, rest houses and administrative buildings were situated according to the function of the building. The majority of the buildings were constructed during the 19th and 20th centuries.

2.2.2 The Development between 1930 and 1950

The pearl oyster was a source of living in the Emirates long before the discovery of oil. Pearl oysters occur naturally on relatively shallow banks in the Gulf (Figure 2.12). But it is not clear when the people of the Emirates first began to harvest this valuable resource: individual pearls have been found in excavations on archaeological sites that date back to at least 7000 years ago.

Figure 2.12: Traditional urban fabric in Emirates cities in the late 1940s
Source: Juma'a Al Majid Centre for Culture & Heritage, 2005

After World War II, Japan began producing and exporting pearls. This caused an economic crisis in the UAE (Kazim, 2014). This caused 18,000 men to emigrate to seek work elsewhere between the 1940s and 1953 (Bukhash, 2000). This was coupled with the discovery of oil in Saudi Arabia, Bahrain and Kuwait (Anderson, 1995). During this period, the architecture began to change with the presence of the British settling along the coasts of the UAE, bringing their values of architecture in buildings that had never been seen before; they were few in numbers due to their unsuitability and the traditional buildings survived. According to Al Mansouri and Al Naim (2005), this may be attributed to the absence of a political framework that was effective in defining the change in the norms and traditions.

When oil exploration started in the 1940s, there were no electricity, plumbing or telecommunications; no modern schools or public hospitals, deep water harbours, bridges or roads (uae.gov.ae, 2014). When a few roads were built during the 1950s, the general urban fabric of the city, particularly the residential areas, had preserved its traditional characteristics. It had responded to the hot-arid climate of the UAE with innovative solutions that were suitable for the region.

Sharjah Airport is the first modern building of the UAE (Figure 2.13). It was constructed in the 1930s when Sharjah Emirate first started air navigation, which paved the way for an influx of new developments in the region. It was a 'stop-off' for passengers *en route* to India and London and later was a fortified hotel.

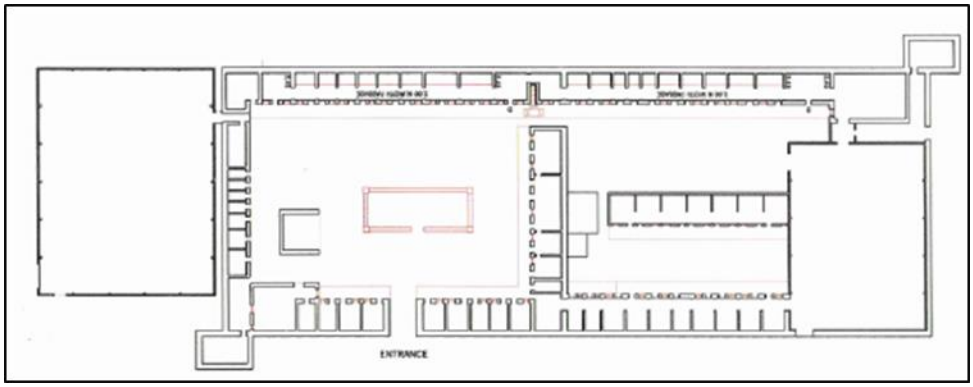

Figure 2.13: Sharjah Airport (1930): the first modern building in the UAE
Source: Sharjah Heritage Directory, 2006

The first Sharjah Airport provided all the amenities of a modern airport despite being small: maintenance, fuelling, passenger services (transit and short-term) and ground services. The first aircraft to land was a British aircraft in 1932 (sdci.gov.ae, 2014). Although the locals built this airport using local materials, the airport was designed by British engineers (Zahla, Rosemarie 1978). The British government financed this building. The Ruler of Sharjah was responsible for construction labour, materials and transportation coming from Abu Mousa Island. The windows, steel angles, doors and corrugated iron were provided by the British government (Anderson, 1995). This was all agreed with the British government and the ruler of Sharjah. In 2000, the

airport building was restored and became the “Station” (Al-Mahattah) Museum in 2000 (Figure 2.14).

Figure 2.14: Sharjah airport in the 1960s and after restoration in the 1990s
Source: uaezayed.com, SKAK, 2006

This airport building and fort (Figure 2.15) is a significant design, combining the traditional and modern, using local building materials and construction with that of colonial architecture. Despite its modern and imported materials such as the roofing and iron beams, it was still able to sustain the heritage elements such as the internal courtyard, arched corridors and solid elevations.

Figure 2.15: Sharjah Airport: combination between modern materials and ambient environment
Source: www.uaezayed.com SKAK, 2006

Another building that was constructed in the 1930s is the Al Wakeel House (Agent's House) (Figure 2.16), for administrative use in Dubai. Sheikh Rashid Al Makhtom built it in 1934 near "Abra" (a traditional boat made of wood used to ferry people) landing close to the creek.

Figure 2.16: Al-Wakeel House: the first office building in Dubai (before and after restoration)
Source: Dubai Municipality, 2007

New building materials were introduced in the country in the middle of the 20th century, such as steel, concrete and glass; electricity to power air conditioning systems revolutionized the former

way of life. Construction of new buildings marked this decade, the majority of which were public buildings with modern materials such as the British Agency built in 1957 (Kay, 1989). During the 1950s, when there was an increasingly permeating use of modern building materials such as steel and concrete, construction methods and techniques of construction had to accelerate. Cement was first imported in 1955 and the first concrete block house was constructed a year later (Heard-Bey, 1982).

Gypsum as a traditional material for construction is much more expensive than cement, so within a few years, the traditional building methods with coral stone and gypsum gradually disappeared and in their place came ready-made concrete blocks. According to Karim, 1999, this was the age of transition from traditional ways and forms of architecture towards contemporary styles and methods. In 1952, with the declaration of the "Coastal Emirates Council" were the catalysts towards the revolution of the modern architecture of the country. Projects were financed by the council, such as hospitals and schools (Heard-Bey, 1982).

Other types of buildings were constructed during this time in order to serve the requirements of the modern development of the country, such as contemporary souqs, schools, hospitals and hotels replacing traditional buildings.

The 1950s experienced an accelerating economic development and this was translated into a significant increase in the new architecture, as well as the Airlines hotel being built in Bur-Dubai and the construction of the first modern street. In 1958, Sheikh Rashid bin Saeed Al-Maktoum, founder of Dubai, signed a contract with an Austrian company to dredge the Dubai Creek to facilitate large ships (Bukhash, 2000). In 1951, the Mahtoum Hospital was the first modern hospital to be constructed in Dubai, and it was to service the whole country (Heard-Bey, 1989). New techniques and materials were used such as steel columns, skeleton structures and concrete blocks (Figure 2.17 & Figure 2.18).

Figure 2.17: Modern buildings in 1950s Dubai; Al Makhtoum Hospital in Dubai
Source: Dyck, 2004

Figure 2.18: Modern buildings in 1950s Dubai; Dubai Municipality building in Deira
Source: Shuckla, 2006

In 1958, the British consultant (European Federation of Consulting Associations), John Harris, was appointed to renovate and expand the Makhtoum Hospital using skeleton concrete (Cantacuzino & Browne, 1977). Harris used wood partitions to add to the regionalism effect of the building to give a shaded entrance and pointed arced beams as the elevation, which was a masked façade, instead of incorporating a traditional cultural dimension, which would have been more in preserving the local architecture (Al-Mansouri & Al-Naim, 2005).

2.2.3 1960-1971: The Direction Towards Modernity

The 1960s could be referred to as the evolution of the built environment. It was a revolutionary period of ideas generally in the Arab world. This was aided by the increased production of oil; and was united with the notion of building a nation under one flag latterly, to become the United Arab Emirates.

"This decade witnessed the most extensive and significant blending of contemporary and traditional in the Arab world that has occurred to several of the small states of the Gulf region such as Abu Dhabi and Dubai; these emirates had experienced dynamic, booming expansions during the 1960s" **(**Ouf, 2000**)**.

In 1963, the first official representative of Kuwait established its office in the Trucial Emirates. Many projects have been built consequently, such as schools, mosques and health buildings. The Development Office of the Trucial States was developed with its headquarters in Dubai, which boosted the growth of buildings and the process of development in the country in 1964 (Herd-Bey, 1982).

2.2.3.1 Multi-storey Buildings in the 1960s

Multi-storey buildings were initially constructed in the 1960s and began spreading in the country (Figure 2.19).

Figure 2.19: Multi-storey buildings forming the area skyline in Dubai in the mid-1960s
Source: Dailymail.co.uk, 2012

Two recognizable buildings from 1962 are along the Abu Dhabi Corniche, the Shore Hotel and the two-story Abu Dhabi Municipal Building, with its front balconies and straight horizontal lines.

The headquarters of the Abu Dhabi National Oil Company (ADNOC) was constructed in 1963 and it was notable for being the first building to use a concrete skeleton; the elevation finishes responded well to the climatic and environmental issues (Al-Mansouri & Al-Naim, 2005).

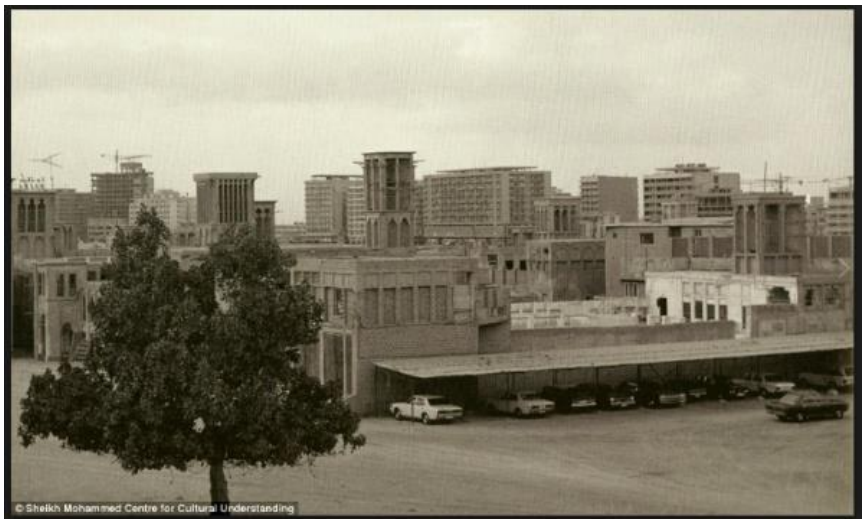

Figure 2.20: Multi-storey buildings on the Dubai creek
Source: Gulf news, 2010

The Creek in Dubai became the business centre and witnessed several multi-storey buildings (Figure 2.20). New hotels were built to keep up with contemporary city life and the increasing numbers of visitors, such as the Ambassador Hotel in Bur and the Carlton Hotel in Deira.

One of the most recognizable structures of this particular period was the First National City Bank of New York (1964) to design a building for the picturesque waterfront of Old Dubai, named "The Creek". In 1967, the bank was completed. The vertical columns are reflected and its strong entablatures and divided bays of the traditional wind towers (Figure 2.21), which are still common among many traditional houses around the location. This building is made of concrete, although some of it was pre-cast with the unplastered surface being exposed. All elevations have patterned screens (mashrabiyas), which allow shading and act as a form of security.

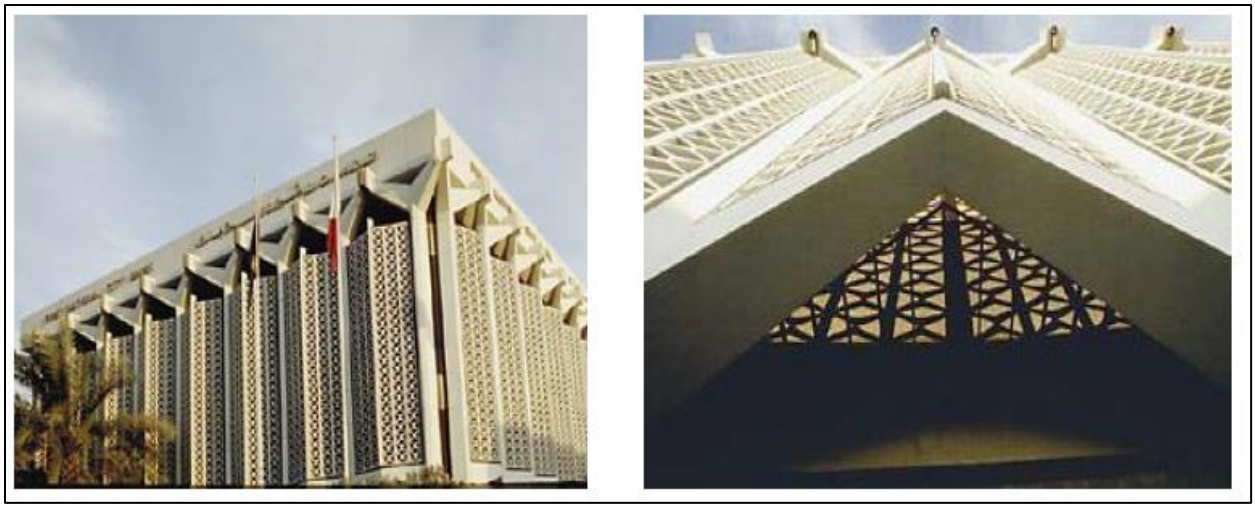

Figure 2.21: The First City Bank of New York with its white screens, Dubai creek
Source: Al-Zubaidi, 2007

At the top, the angled arms hold aluminum cylinders which contain floodlights, for security and decoration. The building is raised on a platform in order to boost the strength of its foundation as ground water was seen near the surface of the building. This platform also allows planting space. The bank's interior is finished in bright colours and the public lobby highlights a mural formed from the white cement perforation as a decoration (Ouf, 2000).

2.2.4 1971: Post-Federal Declaration

The boom in architecture was greatly influenced by significant events, social, economic and cultural changes, independence being an important factor. Wealth had been created during the 1960s and now it was being used to create new major streets and new planning schemes; these replaced the organic and traditionally compact urban fabric with the use of modern construction materials.

Air-conditioning units were fitted in all types of buildings, making the traditional wind tower redundant (Bukhash, 2004).

2.2.5 1971-1990: The Boom in UAE Architecture

After the country's boom of economic and social prosperity, there was a pressing need to construct new buildings to meet the emerging demand. Departments for planning were established in order to conduct municipal and city planning. Construction of housing and public building developments were focused on by the Department of Public Works. Cities expanded rapidly due to the increasing dependency on automobiles. Major cities had transformed into metropolitan areas causing an uncontrollable expansion and influencing the traditional way of life into a contemporary style (Al-Zubaidi, 2007).

Several public housing projects were constructed by the government in different parts of the country. After the completion of construction, the governments handed over the houses to the citizens. The cultural values and necessities of the inhabitants unfortunately do not fit in the design of these houses. The inhabitants were forced to make informal renovations and changes to the houses to satisfy their necessities (Mahgoub, 1997).

Oil revenues enabled this massive speedy modernization. From mud-walled communities, towns have become cities transformed into commercial capitals that have been assimilated in global economies. There was an unparalleled growth in the urbanization of the UAE.

The building boom was rapid and was an exceptional experience for the country; many infrastructure projects started in the 1970s, such as drainage, roads and commercial buildings. More infrastructure projects and modern buildings had begun during the 1980s with some relevance to local culture. A classic example of this is the Al Wasl Hospital, where traditional arches were used, and shade and water pools were introduced into construction techniques. Dependency on technology and modern appliances made people venture towards comfortable lives and new social values; due to this change of lifestyle, traditional heritage identity was altered.

2.2.5.1 Ancient Construction Techniques

By the beginning of the 20th century, construction was mainly made of primitive mud soil available in the deserts, mixing it with water to get brick-shaped mud (Figure 2.22). However,

the settlers utilized the use of coral and shell stones (Figure 2.23 & Figure 2.24) distributed along the beaches in the UAE and coastal regions to replace the usage of unbaked bricks as the main structure component for load-bearing walls. They were cut in blocks and bound together with "Sooraj" (Figure 2.25), which is a blend of red clay and manure or white chalk or water paste (Bukhash, 2004).

Figure 2.22: Mud soil shaped to brick
Source: Bukhash, 2009

Figure 2.23: Coral stone
Source: Bukhash, 2009

Figure 2.24: Shell stone
Source: Bukhash, 2009

Figure 2.25: Burning mud (sooraj)
Source: Bukhash, 2009

That structural system withstands loads up to three storeys high. Roofs and slabs were built out of available timber and tree branches that worked as beams covered with layers of palm leaves

(Figure 2.26). Basic spaces are located on the ground floor, with minor and additional spaces located on the first floor.

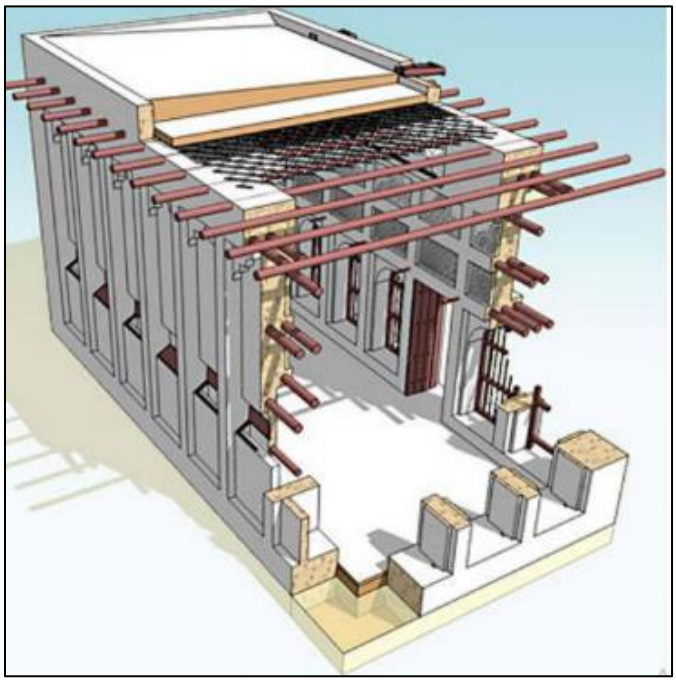

Figure 2.26: The traditional construction method
Source: Bukhash, 2009

These materials allowed people to find compatibility with the harsh environment as it helped in reducing the temperature of the internal spaces of the houses (Yellowpages, UAE 2016).

2.2.5.2 Modern Materials and High Technology in Construction

The use of imported architectural styles, building materials and construction systems had been used during the 1970s and 80s. During this time Arab architects from outside the UAE were starting to have an impact on the country.

Foreign architects followed, and played an even bigger role in the construction and design of new buildings. The use of reinforced concrete, construction technology and modern building materials dominated the practice of architecture in the 1970s and 80s. Mechanical services, high technology and glass facades paved the way towards environmental neglect (Figure 2.27).

Figure 2.27: The architecture of glass and high technology
Source: Al-Zubaidi, 2006

Small windows and wind towers that provided natural ventilation have been replaced by air-conditioning. The excessive availability of oil had been a key factor in the construction of modern buildings that rely heavily on energy. Later, when oil prices fell, this impacted on the Emirates and the style of architecture. There was an impressive integration of modern buildings, though this has unclear links with the Emirati tradition (Zandy, 1993).

2.2.5.3 Inspiration from Traditional Motives

Traditional features had been utilized in many projects in an attempt to execute regionalism into contemporary architecture. The wind tower was the most preferred traditional element that had been applied to modern buildings during this period. Several architects had been successful in adapting the fundamental principles of the wind tower as a theme and model of buildings, since the need for cross-ventilation and air-cooling is paramount. The most famous building of this kind is the Sharjah Central Souq (Figure 2.28), constructed in 1977 and designed by Michael Lyell, where barrel vaulted rooms are combined with the linear traditional market with a series of wind towers to guarantee sufficient circulation of air and natural ventilation. This particular building will be included in the case study to be evaluated later.

Figure 2.28: The Sharjah Central Souq
Source: dubaidays, 2018

Another example of a building where a heritage theme is being employed is the Al-Ittihad School, Dubai, designed by John Harris (1988). In order to provide a variety of sheltered spaces, the approach of the design was to be like a village cluster resembling typical housing. The four school types (infants, junior, middle, and senior) were designed in a spiral form circling an administration block; a concept that was replicated at the level of each school. The roofs, which are made of plywood covered with synthetic rubber sheet, were shaped in a way to emphasize the concept of clusters. The architect, Jafar Tukan, designed the prototype kindergarten in 1977 based on clustered square-shaped individual units adopting activity areas. For classrooms and courtyard ventilation, the building employed a wind tower (Figure 2.29) (Cantacuzino & Browne, 1977).

Figure 2.29: Prototype kindergarten, 1977
Source: Aga Khan Trust for Culture

In many buildings with innovative visions, the inward plan and courtyard design were important. The Civic Design Studio designed the Dubai Municipal Building (Figure 2.30) which was based on a large open courtyard with an oasis that links the round council chamber, the executive section and the city hall. The main concept was elaborated by the designer Kazuyuki.

Figure 2.30: Dubai Municipal Building
Source: dm.gov.ae

Matsushita, 1980 stated:

"After studying and analyzing the project, we decided to propose as a basic concept the idea of a new citizens' plaza, which is the best way to produce a symbol of Dubai's increasing prosperity. We therefore wanted to create on the site, not just a municipal building, but also a green plaza (Mydan) refreshed by the sparkling, beautiful creek that flows by it."

2.2.6 1990-2000

A renewed longing for something more traditional was felt after the first spate of modern buildings, which had completely changed the urban landscapes. There was an increasing awareness in government that an assessment should be carried out on the gradually decreasing potential loss of heritage in the country. Major buildings that were sufficiently intact were restored through renovation projects and architects began to integrate some traditional elements into their designs.

The greatest potential for development of a viable modern regionalism was offered predicatively by traditional architectures that were consistently of high quality and were capable of providing various types of old and new buildings. According to Abed (2001), the potential variety from the pure richness of the heritage over many years had enabled development. The emergence of the new millennium marked qualitative changes in parallel with the globalization. Some projects had soon become part of the national identity such as the Burj Al-Arab (Figure 2.31), and the Baynoona Tower. Regardless of opinion and views, such projects became landmarks.

Figure 2.31: Burj-Al Arab high-rise building in Dubai
Source: Arabianbusiness, 2014

The trend for building architecture based on both Western and Arab designs started with the building of Jumeirah Beach Hotel in the year 1997 (Katodrytis & Mitchell, 2015). This hotel became popular because of its unique design. Moreover, in close proximity to the Jumeirah Beach Hotel, another iconic building called the Burj Al Arab, the popular seven star hotel, was

built in 1999, having been designed by Tom Wright. This hotel became a symbol of UAE's national identity while standing for both luxury and tradition.

These properties built a strong image for UAE's architecture which attracted the world's attention to the property architecture boom taking place in the UAE.

In the last fifteen years, searching for identity in contemporary architecture in the UAE has materialized in two directions: the revitalization of the cultural heritage by the preservation of traditional architecture and the revival of traditional architecture featuring as a growing public interest in the quality of the built environment. (Al-Zubaidi, 2004).

2.2.7 Architecture from 2000-2017

The period from 2000 to 2017 marks the golden era for architecture in the United Arab Emirates. The main reason for this is that several iconic buildings were built in the country during this period such as Burj Khalifa, Atlantis the Palm, Sheikh Zayed Grand Mosque and the heart of Sharjah.
This enabled foreign architects to create an alternative to the pervasive international models and work towards creating the best regional architecture that the UAE can offer.

Due to this, both architects and construction companies wanted to come up with innovative designs and world-class projects to create a more developed image for the country. In the year 2000, the Emirates Towers (Figure 2.32) were built in Dubai and were designed by Hazel Wong (Katodrytis & Mitchell, 2015). These twin towers stood as a new landmark on Sheikh Zayed Road with one of them as an office tower and the other as a hotel.

Figure 2.32: Emirates Towers
Source: yellowpages, 2015

Moreover, the Dubai International Financial Center (Figure 2.33) was launched in 2004. This property not only highlighted the financial strength of the country but also attracted foreign investment by finance companies from a number of countries around the world. The Gate structure of Dubai International Financial Center was developed by Gensler on the basis of London's Canary Wharf (Katodrytis & Mitchell, 2015).

Figure 2.33: Dubai International Financial Center
Source: emirates247, 2018

Furthermore, companies in the UAE worked towards taking advantage of the growth in the tourism and hospitality industry by creating retail and hotel properties in the first decade of the twenty-first century. Ibn Battuta Mall was opened in 2005 and it is the world's largest theme-based mall as it incorporates designs from six different cultures which are India, China, Andalusia, Egypt, Persia, and Tunisia.

Moreover, Atlantis, the Palm (Figure 2.34), was opened in 2008. It is a property designed by Wimberley, Allison, Tong and Goo (WATG) (Katodrytis & Mitchell, 2015). This structure has gained popularity throughout the world for its mix of Arabic and foreign architectural designs.

Figure 2.34: Atlantis the Palm Hotel
Source: Arcadis, 2017

In addition to this, towards the end of the first decade of the twenty-first century, one of the most iconic properties in the UAE was opened in 2010, which is the Burj Khalifa (Figure 2.35). This is the tallest building in the world and was designed by Adrian Smith, Owings and Merrill (SOM).

Figure 2.35: The Burj Khalifa
Source: gulfnews, 2018

Another masterpiece created by the SOM was the Cayan Tower (Figure 2.36) which opened in 2013. This building is not only known for its height of 306m but also for its twist of 90 degrees which makes it remarkable. Moreover, the latest construction masterpiece is the Dubai Frame, which opened on January 1, 2018. The idea for this property was conceived by Mexican artist, Fernando Donis, and completed by Hyder Consulting.

Figure 2.36: The Cayan Tower
Source: som, 2016

Finally, the UAE has been making efforts for the past decade to create architectural designs catering to different cultures, whereby these are based on different themes. This would enable the country to inspire individuals from different cultures who form a large part of the country's population. Moreover, the creation of architectural designs based on different themes led to neglecting the heritage identity of the country in line with the international image of the UAE.

2.2.8 Contemporary Interpretation of Traditional Culture

In the 1990s, a new trend emerged, and its aims were to revitalize the architectural heritage and use its elements to stress the architectural style and identity of the country. Many of the buildings were constructed during the 1970s and were replaced by new buildings using features of architecture assumed to be more related to the region. Some of these attempts were successful while others were overdone (Mahgoub, 1997).

The 1990s is regarded as the maturing stage in the history of architecture of the UAE, where most of the main buildings were constructed with some consideration to traditional architecture and heritage (Figure 2.37). The restoration involved approximately 40 buildings restored into restaurants, museums and shops (Karim, 1999). These features of traditional architecture offer dramatic metaphors for regional forms and logical responses towards the harsh climate, giving contemporary design a subtle yet telling shove in the direction of regionalism (Zarghami & Olfat, 2005).

Figure 2.37: Modern buildings utilizing traditional features
Source: Al-Zubaidi, 2007

A close interconnectedness between contemporary architecture and the character of the traditional environment had been exemplified by these buildings. Tent architecture is one of the more appropriate and oldest architectural systems in the region. The old traditional function of the tent was given exciting contemporary forms. Several shopping centres and multipurpose halls integrated the tent as a symbolic interrelating form to the environment of the desert, such as the Golf Club (Figure 2.38) and the Sahara Mall in Sharjah (Figure 2.39).

Figure 2.38: Golf club, Creek, Dubai
Source: Timeout Dubai, 2017

Figure 2.39: Tent as an identity feature in modern architecture in the UAE: Sahara Mall, Sharjah
Source: Al-Zubaidi, 2006

In Abu Dhabi, the Headquarters for the Marine Operating Company (Figure 2.40) by Jung/Brannen and Nader Ardalan was an attempt to fuse traditions of culture into a contemporary office complex by adding covered interior spaces and interior designs. The tradition of this ancient land is being reinterpreted artistically and authoritatively reinterpreted in the design concept, based on inexhaustible fountainheads of archetypal imagery symbols and

metaphors to cumulatively preserve a memory for the future (Ardalan, 1993). Nader Ardalan wrote about the internal garden revelation:

"The enclosed Paradise Garden theme pervades and inspires the most poignant metaphors in Islamic cultures towards man's harmonious relationship with nature."

Figure 2.40: Marine Operating Company, Abu Dhabi
Source: yellowpages, 2018

Another integrated heritage concept is the internal courtyard with light structure which creates a relation between heritage elements and contemporary buildings, such as the Mall of the Emirates in Dubai (Figure 2.41), the Sahara Mall in Sharjah, and the Wafi Center in Dubai.

Figure 2.41: Mall of The Emirates plan, Dubai
Source: Mario Arroyave, 2017

2.3 What Is Heritage?

"Heritage" has come to refer to buildings, sites and monuments, and is a term that has become increasingly pervasive since the founding of the UNESCO World Heritage Center, in 1972. It is significant to reflect on the measures used by UNESCO to distinguish such sites, although concerned with "world" heritage sites. However, one should consider the repercussions of the measures that were established by the UNESCO convention for the infusion of cultural elements in the list of World Heritage sites. It is also significant to reflect on the term "property" with its overtly economic connotations, and use the term "resource" instead (Camre, 2005).

It is also remarkable that there is a pattern to nominate sites that are often related to great monuments which might work leaning towards certain political agents of human history at the very sacrifice of other agents, whose works and contributions to the civilized world did not correspond to the construction of exceptional buildings and monuments. Hence, there is a problem with the word "monument". In fact, a suggestion by the then Secretary General of ICOMIS, Jean-Louis Luxen in 2002 that the range of heritage sites could be widened, in a change of term from "sites and monuments" to "cultural heritage" to infuse landscapes, roads, and conventional structures (Zarghami & Olfat, 2005).

UNESCO's convention, in Article 24.6, states that a monument should be either tangibly or directly related to living traditions or events, with beliefs and ideas with artistic and fictional works that can be classified with outstanding universal importance, though the committee is in the process of consideration that the measure could also be inclusive of the list only in exceptional circumstances, or in parallel with other criteria, either natural or cultural.

Since 1972, cultural landscape and the intangible heritage were the two notable additions towards the UNESCO Convention. In a landmark decision, in 1992, the list of World Heritage sites was widened so that it will be inclusive of natural and sacred sites, living cultural places and cultural landscapes.

By definition, heritage means inherited; however, such inheritance is often a point of contest and often, heritage rights are infringed in the contemporary world (stanford.edu - Department of Anthropology, 2014). Moreover, there is increasing reference to heritage as a form of making the past a commodity. According to Parkes Shire Council (2014), heritage is the evidence of the past, like a natural environment, such as aboriginal sites, historical sites, relics, buildings, or places that are considered collectively as the inheritance of the current-day society and that there is a willingness of protection by the community for the future generations.

Etymologically, heritage is being viewed as an interchangeable relationship. The majority of the definitions of heritage emphasize and concentrate on the quality as a thing (or a group of things) that is being transferred from one generation to the next (Veldpaus, 2015). These relationships are negotiated and mediated, which makes the quantification of these exchanges tedious and difficult to achieve. A series of institutional legislations, charters, policy documents and national constitutions had established a body of policies, terms and social behaviour precedents for the management of the benefit and cost of the heritage exchange of the relationship (Veldpaus, 2015).

According to ICOMOS (2007), heritage is established by wilful acts of choice. Heritage maintenance as a choice points in the direction of beliefs in an image of a time which has passed, which supplements, augments and inspires a time in the future.

The definition of UNESCO when it comes to heritage includes works of monumental sculpture, architectural works and paintings, elements or structures of an archeological nature, cave dwellings, inscriptions and the mixtures of such features which are universally outstanding in value from the point of view of history, science and art (Rappoport Heritage Consultants, 2014).

According to Cerna (2017), the term heritage replaced the concept of historical monument four decades ago. This particular suggestion is somewhat changeable, since prior to the 1970s, the term “historical monument” was used widely on a global level, it was applied to architecture with historic and artistic value. At that point in time, the international movement for the

protection of historical monuments and cultural property was more preoccupied with the past endurance by connoting historical monuments.

"*The concept of a historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or a historic event. This applies not only to great works of art but also to more modest works of the past which have acquired cultural significance with the passing of time*" (International Council on Monuments and Sites, 2014).

In 1969, upon the meeting of the European Conference of Ministers held in Brussels, the term heritage began gaining significance. In this particular conference, heritage was contrasted with the term monument, as seen in the subsequent recommendation which is termed as the Recommendation of the European Conference of Ministers Responsible for the Preservation and Rehabilitation of the Cultural Heritage of Monuments and Sites (International Council on Monuments and Sites, 2014).

In 1972, it became an international term when UNESCO announced the Convention Concerning the Protection of the World Cultural and Natural Heritage. Through the Committee of Ministers, the Council used the term heritage by heading its charter with regard to architecture 'European Charter of the Architectural Heritage' (1975). The term heritage was used as a representation of the culture of Europe, aside from the documents of the European Union's document with regard to culture in the 1970s. During the 1970s, the concept of heritage was reevaluated to include three new characteristics:

It includes all natural resources as natural heritage and it comprises landscapes, outstanding parks and natural sites.

Cultural heritage implies a broad spectrum such as monuments, groups of buildings and sites, which includes architecture.

Recent cultural assets and buildings include industrial heritage tools in old factories, buildings in docks and coal mine sites. In the sense that the artistic value is not the sole criterion in order to judge which artifact can be considered as a heritage, this can be considered a new phenomenon.

The purpose of this research allows the discussion to focus on the second character, which specifically espouses architectural heritage. Architecture is referred to as the built environment which is constructed and designed by man. It consists of the practical and aesthetic functions which provide humans with an opportunity to show their ideas to the outside world. It symbolizes the different ways in which human beings manage various spaces by creating mirrors in architecture of how they perceive themselves.

The current initiative is to widen the scope of heritage as a concept, integrating with it intangible heritage resources in order to accentuate the worth for the communities of those sites and, more importantly, to recognize that heritage is within the social matrix and that it serves the social aims and is thus implanted in both the national and international communities.

2.3.1 Heritage Definition in the Arab World

On the other hand and in the meantime, the stress on heritage as a national asset was in contrast to the veneration of particular places and artifacts for the purpose of obtaining spiritual guidance (the Ka'bam; the tree of Mariam in Egypt and Mount Sinai). Heritage in Arabic is generally translated as "turath" and comes from the word "waratha" meaning to inherit. This word is related to "mirath", meaning inheritance, which refers to the estate, funds and other resources that are passed from one person to another upon death according to a prescribed order, and such inheritance may be invested or squandered.

The world "turath" is used to refer to the inherited collection of knowledge that is passed on in both written and oral texts, while "mirath" has an economic connotation. In the Arab world, the word is indeed used often, such as the "Kutub el Turath" which points to the book that dates back to Islam's early centuries and contains the founding principle of Islamic traditions. Perhaps, it is important to maintain both dimensions of heritage which cannot be separated:

Its value in terms of economics, which is relative to its material worth, the services and goods that may be sourced from it relative to the maintenance cost and preservation.

Aesthetic, recreational, religious, ancestral, intellectual, scientific and historical value of the heritage.

2.3.2 The Value of Heritage

The concept of heritage means that there is an inherent worth that is being conferred upon a place, an object, an institution or a particular collection of actions that are made up from its relation to some aspect of the past, as interpreted and immortalized by a single or a set of communities.

International communities tend to be represented by a particular group of regional and local populations, which are in turn represented by the government, its officials, well-known personalities, intellectuals, academics and business executives.

When revolutionaries began to destroy castles, monasteries and palaces as well as other old regime icons, it was that time when the concept of heritage gained more importance in Europe, during the French Revolution in 1792.

The conventions which are headed revolution decided to protect such monuments as a symbol of wealth in that country to put at the service of the new regime; hence they became alarmed by this loss and started to give the old regime legitimacy and historical dimension (Pendlebury, 2009).

The purchase of antiquities, looting and other systematic excavations became a method by which nations from Europe transferred to their own museums and research agencies the monuments and memorials of ancient civilizations, as any guest can see at the British Museum or the Louvre. This appropriation of antiquities not only detaches them from their main context, making them rare antiques or objects of art, but also offers to scholars from the west the material for the production of knowledge of archaeology that serves their goals and objectives, as well as the

European nation's political agenda. Meanwhile, there was no encouragement from the local communities to participate in the exploration of their own past and they were prohibited even to run their own national departments of antiquities (Reid, 2000).

2.3.3 Heritage Management

Heritage management as a cultural practice has long been primarily about conserving the fabric of the past for future generations (Pendlebury, 2009). Architectural conservation defines the method via which the material, historical, and design reliability of humanity's constructed heritage are extended through careful, deliberate interventions. The individual engaged in this pursuit is referred to as an architectural conservator-restorer. Choosing when and how to have interactions in an intervention are vital to the last conservation-restoration of cultural heritage.

In heritage theory, the trend is to recommend a holistic, integrated and multidisciplinary management of resources to overcome the dichotomy of conservation and development (Veldpaus, 2015).

In the long run, the selection is primarily fee-based: a combination of inventive, contextual, and informational values is commonly considered. In a few cases, a decision to no longer interfere may be the most appropriate preference (HBRC, 2014).

Architectural conservation as a movement started growing during the 18th and 19th centuries. It started as a reaction towards Modernism and its corresponding architectural perspective, which avoided any sort of attachment to old buildings and structures, for technological architectural progress. Before that, buildings would stand for their cultural or religious importance.

The growth of the movement happened parallel to the significant progress in the archaeological discovery and scientific advancement fields. And because of these two schools, more importance was given to architectural conservation.

The movement from there started going in two directions, which are as follows:

Preservation/conservation refers to the architectural school of thought, that believed in either imposing regulations to protect and maintain buildings in their current state, or would avert any

further damages to them. Artist William Morris and art critic John Ruskin were two of the main supporters of this direction of the movement.

Restoration has to do with the conservationist school of thought, that believed historic buildings could be improved to become better structures, or even completed ones using modern materials with high technologies. It's very similar to Modernist architectural theory, except it does not advocate the destruction of ancient structures. The French architect Eugene Violet-Le-Duc is the best example of the supporters of this belief.

Many organizations worked to increase the awareness of the importance of keeping ancient historical buildings all over the world; below is a brief list of architectural conservation organizations:

AIC-ASG (The American Institute for Conservation - Architectural Specialty Group)
IHBC (The Institute of Historic Building Conservation)
SPAB (The Society for the Protection of Ancient Buildings, a member of the UK's Joint Committee of the National Amenity Societies)
UNESCO World Heritage Centre
Council of Europe, Architectural and Archaeological Heritage
APTI (The Association for Preservation Technology International)
International Council on Monuments and Sites
The International Scientific Committee on the Analysis and Restoration of Structures of Architectural Heritage

All over the world, many countries have started to manage their regulations to save their heritage buildings and structures, such as the United Kingdom, Japan and India.

Several concrete actions have been undertaken to combat illicit trafficking of cultural buildings. The most important regulation was the 'listing' which lists heritage buildings under A-listed buildings, which are buildings that have been placed on the Statutory List of Buildings of Special Architectural or Historical Interest, and cannot be demolished, extended or altered without special permission from the local planning authority (historicengland.org.uk).

These buildings are divided into three grades as follows:

Grade I: buildings of exceptional interest, sometimes considered to be internationally important (Figure 2.42).

Figure 2.42: The Johnny Haynes stand at Craven Cottage
Source: footballtripper, 2015

- Grade II: "particularly important buildings of more than special interest" (Figure 2.43).

Figure 2.43: Buckingham Palace; home of the British monarch

Source: www.countryliving.co.uk, 2011

- Grade III: buildings that are "nationally important and of special interest" (Figure 2.44).

Figure 2.44: Alexandra Palace, London
Source: Visit London

Moving to Asia, Japan is the best example of the restoration countries. Many valuable buildings were protected by stakeholders for the following purposes: cultural, religious and educational. Modern Japan was formed with the 1868 Meiji restoration. Protecting heritage was a public policy for the sake of the entire nation.

In 1949, a fire at Horyu-ji temple, the oldest wooden structure in Japan (now included in the World Heritage List), destroyed outstanding wall paintings in its Buddha Hall. This accident induced a strong national sentiment for cultural protection, which led to the enactment of the Law for the Protection of Cultural Properties in 1950. Under LPCP, the national and local governments were requested to take necessary measures for protecting heritage (Kakiuchi, Emiko, 2017).

Cultural properties are defined by LPCP as cultural productions of historic, artistic and/or academic value for Japan. They are essential for understanding the history and culture of the country, and form the foundation for cultural progress.

The government also undertook a range of measures for protection, which includes preservation.

Three categories were introduced as cultural properties, at the time of its enactment in 1950, to be protected by LPCP. The first category, Tangible Cultural Properties, is composed of two elements:

1. Buildings and structures (immovable cultural properties) such as the five-storey pagoda (Park, Tanya, 2014) (Figure 2.45).

Figure 2.45: Five-storey pagoda
Source: www.muse.jhu.edu

2. Works of fine art (movable cultural properties) such as crafts, paintings, sculptures (Figure 2.46).

Figure 2.46: Buddhist statue
Source: www.muse.jhu.edu

On the other hand, in the UAE only a few policies were suggested when considering conservation of the traditional urban fabric.

The preferred scheme of building was unfortunately the idea of demolishing the traditional fabric in part or in full, in accordance with foreign values that are not relevant to the society traditions and way of life (Anderson, 1995). Especially in the 1970s and 1980s, during the architectural boom, many traditional heritage symbols were demolished for representing poverty and being old-fashioned.

Merchant houses in Bastakia (Dubai), which were considered remarkable, were demolished to give way for the Ruler's Court, as is the case with the British Agent's residence in the Muraijah (Sharjah) district which was replaced by the Central Souq (Anderson, 1995). In order to build new modern streets, many buildings within the traditional urban fabric were demolished without any historical or cultural consideration. In the late 1980s and early 1990s, there was increasing interest among the general public for traditional architecture and the quality of the built environment as a broader concept. There was concern for the future, besides being nostalgic (Mahgoub, 1997).

In the last 10-15 years, the traditional core of the UAE has been on preservation alert; some traditional fabric and buildings that survived have been restored (Figure 2.47), such as: the Shandagha and the Bastakiya districts of Dubai, the Shawaihen and Muraijah districts in Sharjah,

and some historic forts and houses all over the country. It has been an attempt to conserve the identity of these traditional buildings; the policy was to rejuvenate these sectors responding to the busy life of the city.

Figure 2.47: Restored traditional buildings, Sharjah
Source: constructionweekonline, 2010

Architectural heritage revitalization and conservation of cultural values in an environmentally sensitive manner necessitates detailed planning, clear knowledge of materials and their interactions, construction knowledge, skilled technicians, craft techniques and available resources.

2.4 Islamic Architecture, Defined

Early Islamic architecture, exemplified by the Dome of the Rock, Jerusalem (AD691) and the Great Mosque, Damascus (705), drew on Christian architectural features such as domes, columnar arches, and mosaics, but also included large courts. Islamic architecture owes its origin to similar structures existing in Roman, Byzantine, and Persian lands, which Muslims conquered in the 7^{th} and 8^{th} centuries.

While there are a variety of plans, building materials, elevations and decorative styles in Islamic architecture, there are several forms recurring that can be observed in all types of buildings, regardless of it being religious, secular, public or private. This research will be focusing on heritage elements that blend with Islamic architecture (Figure 2.48).

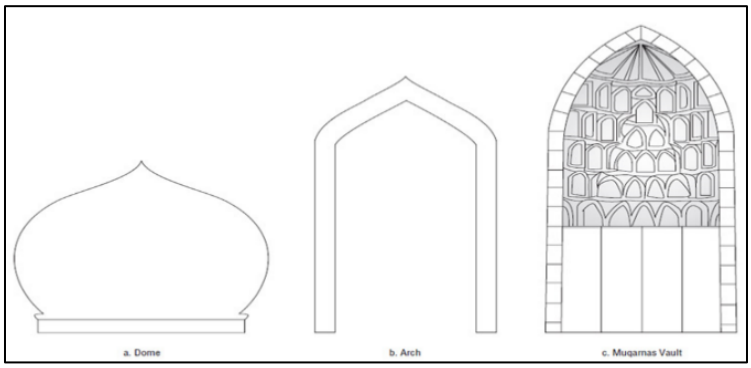

Figure 2.48: The Islamic basic architectural elements
Source: Kavuri-Bauer, 2009

2.4.1 The Mosque

The pre-eminent dynamic space that stands at the focal point of the Islamic society and culture is the mosque. It is a site of spiritual worship, social gathering, debate, education, and discussion of religion, current events and politics (Kavuri-Bauer, 2014). The first builders of architectural mosques were Arab caliphs from a Bedouin culture that does not require permanent architectural mosques; these early Islamic leaders adopted and adapted the building traditions of the cultures that were able to capture the guide to formation and style of the new mosques. The Byzantine and Sassanian Empires were the two prominent sources that contributed to the early forms and styles of mosques. In the regions that were captured and dominated by these Arab cultures, garrison cities were established and mosques were built to provide the community with a space to pray and meet (Kavuri-Bauer, 2014). The mosques that emerged in the first century of Islamic history were new buildings that were constructed from recycled parts of abandoned buildings, such as Roman ruins or churches belonging to Christians that were transformed into mosques. Byzantine artisans practised in mosaic design were employed by some Islamic rulers, such as the builders of the Great Mosque, Damascus (706-714 C.E.) (Figure 2.49) and the Umayyad builders of the Dome of the Rock, Jerusalem (completed in 692 C.E.) to decorate their structures with Quranic inscriptions and vegetation (Figure 2.50).

Figure 2.49: The Great Mosque of Damascus
Source: Panoramio.com

Figure 2.50: Dome of the Rock, Jerusalem (Qubbat As-Sakhrah)
Source: en.protothema.gr, 2018

The practice of using local building techniques, architectural forms and decorative elements subsequently resulted in mosques of different regions and periods of the Islamic world emerging, visually dissimilar. The basic and principal function of providing a central space for the Islamic community to unite, pray and exchange information, connected all these mosques. The first constructed mosque was the house of the Prophet Muhammad. It was built soon after his community migrated in 622 C.E. to Medina, Saudi Arabia, characterized by a simple, unremarkable enclosure. The principal factor of consideration for the mosque of the Prophet Muhammad was to provide an open and large expandable courtyard so the growing community could meet at a single place (Kavuri-Bauer, 2014) (Figure 2.51).

Figure 2.51: The house of the Prophet Mohammad
Source: Naqvi, 2006.

2.4.2 Varieties of Mosques

There are two types of mosques: the masjid ("to prostrate oneself") and the jami'a masjid or congregational mosques ("to gather"). The masjids are mosques of small communities which are used daily by members of a neighbourhood or an ethnic group inside a city. Masjids were also built as a secondary structure near palaces, mausoleums, caravansaries and madrasas (educational institutions).

In earlier times, the masjids and jami'a masjids shared the same architectural forms and styles, varying in size. As Islamic rulers became more wealthy and powerful at the end of the 7th century, they constructed monumental jami'a masjids in their respective cities to portray the pre-eminence of Islam and their dynasties. Adapting the fundamental elements of arches, vaults and domes, these rulers built mosques that from the exterior emerged to span large areas. To create a visual status experience in the interiors, the jami'a masjids were ornamented with complex arabesque and geometric or vegetal decoration in stucco and mosaic. Quartered marble was used as lower wall decoration (Kavuri-Bauer, 2014).

2.4.4 Residential Architecture

The final type of Islamic architecture to be considered is domestic. The typical house built in Islamic societies is oriented with a broken entrance that turns at a sharp angle which marks the transition from the outside world to the home. The entrances do not usually align with those across the street, so the privacy of the interior is maintained. The inside rooms are arranged around a central courtyard and range from the private spaces of the family to semi-private spaces where male guests, who were not members of the family, could enter. The open courtyard ventilates the house.

In more prosperous households, delicately carved mashrabiya (wooden lattices) were used to create private space, filter air from the outside and allow natural light to enter the house. The exterior of houses is often left plain. Only upon entering the house will the visitor know the status of wealth of the owner.

2.5 Heritage Elements

There is no formal literature to guide this research in establishing a formal definition of what are heritage elements, most particularly from the architectural heritage of the UAE. However, guided by the definition of heritage, perhaps it is best to create a particular definition that would collaborate in parallel with what are the architectural elements that are still pervasive in contemporary architecture, unconsciously derived from past heritage (Embaby, 2014), establishing that the majority of definitions of heritage emphasize and concentrate on architectural heritage, which are those concepts with respect to architectural design that is being transferred from one generation to the next.

Heritage elements are the different combinations that make a formal composition, creating an architectural design, symmetry, pattern, balance, contrast, proportion, unity and theme. These are a combination of lines, colours, shapes and textures which do not give meaning by themselves if they exist in isolation. It is essential that such a variety of elements used in a particular architectural structure blend together well so that the design appears to be in harmony.

In analyzing the different elements that will lead us to determine, identify and establish the different heritage elements of architecture of the UAE, it is essential to consider its relation to Islamic architecture, since the UAE is dramatically influenced by the culture and traditions of Islam.

2.5.1 Pattern Repetition

When there is a repetition of lines and shapes, they create a pattern, which is either regular or irregular, though architects attempt to repeat elements of design in a manner that is regular.

In architecture, such regularity happens; for example, in patterns created by the way bricks are laid in repeated shapes of windows, arches, rows of columns and in decorative stones or wood trims. One of the most useful and very basic of Islamic patterns is repetition. Complex patterns are often created out of the interlocking design of these basic shapes. The repetition of circles, triangles, squares and pentagons are common in Islamic patterns (Critchlow, 1999).

With careful observation of the pattern of the building or structure, a rhythm can be seen. A dynamic quality of the building is a result of the rhythmic patterns, which give life to the architectural design. The repeated arches and rows of columns are rhythms of a building.

According to Nasr (1997), a doctrine of unity is what is symbolized in the rhythms which are a central element in Islamic art and architecture on the basis of ratio and proportions in mathematics, as a central concept of Islam. The rule of geometric construction and the infinitely repeating geometrical patterns are a symbol of the unchanging laws of God as seen in the rhythms of creation and be expressed according to the process of design. Rhythms are demonstrated dominantly in Islamic art and it symbolizes a strong mode of expression among Emiratis, combining aesthetics and functions. The mashrabiya as an architectural element is a fine example of the rhythms (Figure 2.52).

Figure 2.52: A rhythmic pattern in a mashrabiya
Source 1Arch Daily, 2007.

2.5.2 Symmetry

Islam bans the worship of idols and discourages its followers from creating images of living creatures to stop the temptation of worshipping man's artworks (Oweis, 2002). This resulted in alternative methods of creating art and established the use of symmetry and geometric patterns, which has become a popular theme in both art and architecture in Islam. Geometrical symmetries are very common in the Emirati traditional house as heavily influenced by Islamic culture and tradition.

The barjeel (Figure 2.53) is a very good example of geometrical symmetry. Because of symmetry being one of the elements that serve as criteria among elements, the barjeel, mashrabiya, courtyards and broken entrances are considered as part of our architectural elements and therefore heritage.

Figure 2.53: One of the barjeels in Bastakia District, Dubai
Source: Al –Zubaidi, 2007

Balance is an attribute where there are opposing equal weights against opposing sides. In both art and architecture, it is understood that there is balance if the shapes on one side appear to have an equal weight with those on the opposite side. Regardless of the symmetry or the asymmetry of a particular building, it can be classified as balanced when the visual weight on both sides of a particular centre line are equal through the façade.

Islamic artists developed a new vocabulary using a number of forms: arabesque, geometric, floral and calligraphic, which are often interwoven, reflecting balance and harmony.

The architectural concept has been very preoccupied with privacy and private space, which resulted in an emphasis on functionality that gives contrast by means of controlling the effects of light and shade through the mashrabiya in both Islamic and Emirati culture. The privacy of the house has been made more reliable by means of this heritage element, which shall be discussed more clearly in the succeeding sections. In Emirati culture, the use of light is another side, though the question is always how to allow light without letting in excessive heat. The solution is a small opening like a clerestory, which is filled with delicate traceries. As they filtered light into the rooms, arabesque mashrabiya screens were both decorative and functional, allowing air to flow while filtering light into rooms, thereby creating a valuable heritage element (Hawker , 2008).

2.6 UAE Architectural Heritage Elements

There are many distinctive examples of traditional architecture across the UAE. Originally house design continued to retain many traditional elements that are now used more dominantly as part of the aesthetic rather than the functional, such as the mashrabiya, wind tower, courtyard and the broken entrance.

Traditional UAE houses are best expressed using the Islamic term 'Sakinah', which comes from the Arabic word meaning purity and peace. These houses were built to local specifications; which included traditional, cultural and religious requirements. Each element within the Emirati house represented a particular solution or response towards particular problems of dwelling in an extreme environment and with Islamic prescriptions, resulting in a unified and harmonious built environment. These traditional houses symbolize an art form that resulted from the understanding of a religious and cultural life.

Islamic tradition rules define the roles of men and women within the physical environment. Privacy is an essential part of the culture. It is also essential that the Emirati house has a visual privacy producing an inward-looking plan with plain, high external walls to stop strangers from viewing inside. Not only is this a cultural and religious need but also a climatic factor; where shadows would be created on the external walking alleys between the houses.

Having discussed traditional elements of the house, the following paragraphs will explain the most important parts of residential architecture that have crept into and been used as other functions in contemporary building design.

2.6.1 The Mashrabiya

Another important element used to cover openings as well as to attain thermal comfort and privacy in a house is the mashrabiya (Mohamed, 2015). This term is derived originally from the Arabic word “drink”, hence, the particular place is translated as a “drinking place”.

This is a space that is cantilevered and covered with a lattice opening, and where water jars are placed and cooled by the effect of evaporation as air moves through the opening (Figure 2.54).

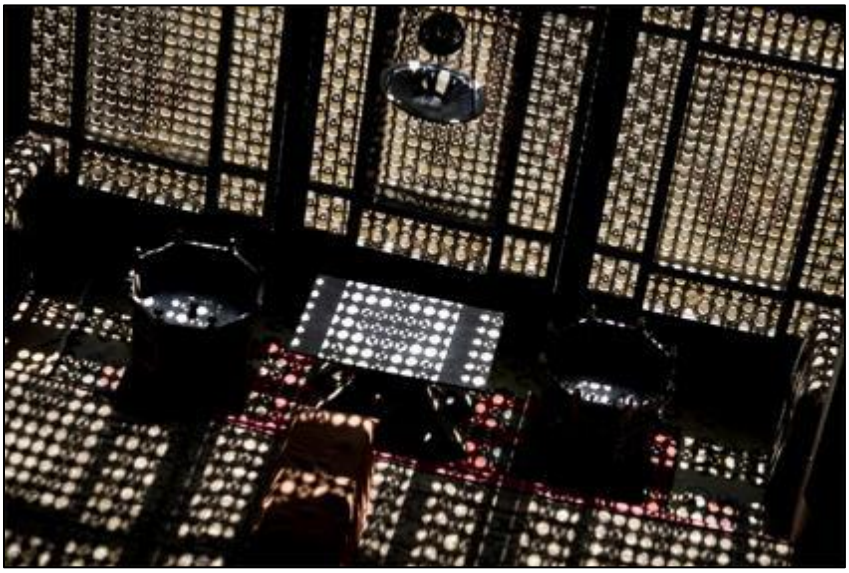

Figure 2.54: Water elements cooled by air passing through mashrabiyas
Source: Newman and Haddad, 2013

The mashrabiya consists of small wooden circular balusters that were designed at specific intervals in a decorative and geometrical intricate pattern. There are five functions performed by the mashrabiya and according to its design, it may serve one or more of these functions. These functions are controlling the flow and temperature of air, controlling natural light, ensuring privacy, and enhancing the aesthetic and social requirements of the interiors (Figure 2.55). In order to perform a particular function, the size of the interstices and the diameter of the balusters could be adjusted (Abdel-Gawad, 2012).

Figure 2.55: The mashrabiya pattern
Source: ehabweb.net.2

Different patterns have been designed to meet a variety of conditions and needs that require emphasis in one or more of the functions that are stated above. Each particular mashrabiya was designed and selected to perform one function or a combination of functions. The size of the interstices (the size in between adjacent balusters) and the diameter of the balusters are adjusted in the design (Figure 2.56).

Figure 2.56: Different mashrabiya designs and patterns
Source: Shearer and Sulṭān, 1986

At eye level, the mashrabiya balusters are set close together with very small interstitial spacing, both to reduce the dazzle of contrasting elements in the pattern and to intercept direct sunlight. The interstices are much larger in the upper part of the mashrabiya in order to compensate for the accompanying dimming effect. A mashrabiya with large interstices will ensure as much open area in the lattice to provide flow of air into the room.

An open, large interstices pattern can be used in the upper part of the mashrabiya near the overhead where sunlight considerations require small interstices and inadequate air is provided. For this basis, a traditional mashrabiya consists of two parts: an upper section filled with a wide mesh of wood pattern and a lower section with narrow baluster in close mesh.

The mashrabiya dimensions are increased to cover any size opening even to the point of filling in the entire façade of the room. The very large size of such mashrabiya will also help in the compensation for the dimming effect of the screen. In some houses, the mashrabiya is also installed indoors between rooms for cross ventilation, and is mainly used in hot and arid areas. There is a close relation between its humidifying and cooling effect. The organic wood fibres of the mashrabiya readily retain, absorb and release considerable amounts of water to decrease the humidity in air flow (Cook, 2000).

There is an absolute and relative size for the balusters and interstices of the mashrabiya based on the area of the surface exposed to the air and the rate at which the air passes through. If there is increase in surface area by the size of the baluster, the humidification and cooling is increased as well.

A large baluster has more surface area to absorb water vapour and serves as a surface for evaporation and also more volume, which implies that it has more capacity and will therefore release the water for evaporation over a longer period.

In addition to these physical effects, the mashrabiya has an important social purpose: it guarantees privacy for the inhabitants from the outside while at the same time allowing them to

view the outside through the screen. The mashrabiya that is covering an opening that overlooks the street has small interstices, except at the top, far above eye level. The external view is quite clear and only slightly obstructed when focusing beyond the lattice.

Courtyards would be filled with desert plants (Figure 2.57) that would act as sinks for the night air, keeping it until day when it would flow out into the air as it passed through the various rooms while wind towers and high ceiling walls exhaust the hot air up and exit the building, consequently providing a comfortable way of living in the extreme climate conditions of the UAE. The problems were with dark rooms, they were not ideal or very healthy, they had a lack of airflow and consequently were stuffy with restricted airflow.

Figure 2.57: The house of Suhaymi mashrabiya
Source: Abdel Gelil,2006

The mashrabiya was the solution, feeling cooler with a breeze and giving ambient light yet restricting direct light. They are objects of beauty and have become valuable; not only are they visually pleasing from the exterior and interior, but they are an architectural element with functionality (Figure 2.58).

Figure 2.58: Different pattern mashrabiya
Source: Mary Marcus

2.6.1.1 History

According to Briggs (1974), the mashrabiya's beginning can be traced to Egyptian Coptic churches. The earliest example can be found in the 13th century with Ayyubid cenotaphs in the mosque of Imam Ash-Shafi, Egypt in the tomb of Sultan Qalawum in the surrounding railings (Briggs, 1974).

From this point, particularly in the reign of the Ottomans in Egypt (circa 1517-1805), the mashrabiya began to be used in domestic residences (Kenzari & Elsheshtawy, 2003).

Due to the effectiveness of the mashrabiya creating a thermally comfortable internal environment, it spread throughout the arid and hot countries of the Middle East, such as Cairo in Egypt, Basra in Iraq and Jeddah in Saudi Arabia (Kenzari & Elsheshtawy, 2003).

As each country began to adopt the use of the mashrabiya, it was then adjusted to suit particular needs, functions, climate and cultural requirements within each individual country.

In Alexandria, Egypt, these are made of turned woods, which are similar to that in Cairo which has less elaborative design. In contrast, the houses in Mansurah, Egypt, the mashrabiyas are filled with a trellis formed of delicate fleeted strips of wood (Briggs, 1974). No matter the types of design, they all perform the same functional effect (Kenzari & Elsheshtawy, 2003).

2.6.1.2 Function of the Mashrabiya

To further understand how the mashrabiya becomes an essential architectural element of UAE, one must first determine the different functions to better utilize it from an architectural point of view. Strict building typologies are required for the suffocating heat of the Middle East which involves large areas of thermal mass, small openings and shaded interiors. In order to increase the amount of ambient light and airflow, the mashrabiya was developed, allowing the building to be cooled while creating a link between the outside world and the inside.

2.6.1.2.1 Controlling the Flow and Temperature of Air

Perspiration is one of the primary methods of human processes in which humans cool themselves to counter the external temperature. Through a process of heat transfer, the sweat cools the skin as it evaporates from the body of the person.

In order for this process to be effective and continuous, an adequate airflow rate is needed to convey the emitted water vapour towards the outside, away from the skin, as evaporation will happen if the adjacent air has the capacity of increasing humidity.

This implies that air movement will increase the rate of heat loss hence, in order for significant cooling to be achieved, a gentle breeze is required (Fathy, 1986). For this reason, it is significant that the buildings must have a steady and constant inflow of air internally.

To ensure cross-ventilation, the layout of the rooms traditionally provided interconnected mashrabiyas providing large openings that are required while still restricting any direct access.

The apparent temperature within the building is determined by the location, construction and sizing of the mashrabiya. There is a proportional relationship between the airflow rate and the porosity of the screen, meaning that if the interstice comprises 80% of the total mashrabiya area, then the airflow through the opening will be at 80% of what it would have been without the mashrabiya being installed (Fathy, 1986).

The consequence is a similar reduction in the capacity of cooling the airflow. If airflow is viewed in conjunction with the evaporative cooling technique, then the criteria for determining the mashrabiya's optimum dimension would be established.

Through determining the desired flow rate, the optimum size of the mashrabiya can therefore be calculated by determining the porosity of the screen and the desired flow rate, as well as the airflow driver.

In Middle Eastern cities such as the cities of the UAE, ventilation in the houses is often driven by one of the two methods: airflow due to differential temperature and airflow due to differential pressure. The mashrabiya is used in both of these circumstances; the mashrabiya acts as the primary inlet for the air and thus serves a critical purpose in how it flows through the spaces.

Simple openings on the opposing walls of a room can be positioned to create a differential pressure between the outlet and the inlet, which consequently results in airflow between the two (Fathy, 1986).

There is still a necessity for flow of air through the room. And for this particular reason, the use of temperature differential creating airflow can be a much more reliable and convenient method of cooling a place. Air is warmed and raised while being replaced by cooler air (Fathy, 1986).

2.6.1.2.2 Controlling Natural Light

Reducing internal solar gain and blocking summer sun was the most important role of the mashrabiya, while at the same time it enables a small quantity of light inward during the cold winter months. The key to controlling this particular aspect of when and how much direct

sunlight will be allowed inside the building is the design of the mashrabiya. By closely spaced balusters, the summer light was blocked; however, in winter the angle of the sun was much lower in the sky and could heat the building from the inside through the interstices.

The building is also required to provide sufficient internal daylight despite the fact that it needs to block direct light to allow for regular activities to occur. Within arid and dry climates, diffused daylight is very useful as it can create well-lit interior living space without compromising on the increase of heat, which means using the maximum indirect and internally reflected light as to the most appropriate form of daylight (Nielsen, 2002).

The size and porosity of the mashrabiya are the two factors in which the amount of diffused light, along with the materiality and reflectivity of the balusters are controlled (Aljofi, 2005). These parameters control how much ambient light may go inside and would determine what tasks are able to be performed by the inhabitants.
Due to the insubstantial atmosphere of the UAE, the climate is extremely hostile and harsh and often contrasts sharply with the darkened interior of the building (Aljofi, 2005). A high level of light reflected from the ground (Konya & Vandenberg, 2011), which creates an unbearable glare.

An intense visual discomfort is caused by the extreme variation in light levels and an adequate visual buffer zone is needed in areas of transition from the exterior towards the interior. The mashrabiya controls the glare and reflected ground light (Fathy, 1986).

Fathy (1986) stated that the light is graduated by the circular section balusters as it reached its surface; thus the contrast is smoothed between the darkness of the opaque baluster and the brightness of the glare entering through the interstices, therefore the users' sight is not dazzled by the light contrast.

2.6.1.2.3 Visual Privacy

An important issue most especially in a predominantly Islamic culture of the UAE, privacy is regarded with high standards of strictness, particularly those concerning with women. Traditional Islamic buildings seek to restrict views of the buildings.

The inhabitants are allowed by the closely spaced bars of the mashrabiya to see out, but for those on the outside, the inside is far outshone by the brightness caused by the balusters, while the opposite is true for the view of the inhabitants (Mohamed, 2015).

As the external conditions became brighter, the focus and the small balusters of the mashrabiya would decrease in visual dominance due to the scale and the sheer number. In terms of transparency, what would appear from the outside would become lacelike from the inside. A combination of screen porosity and lighting conditions controlled this particular factor.

A mashrabiya could change from being visually opaque to having the appearance of being completely transparent by manipulating these two factors. The basic principle of optics was extraordinarily effective in creating the desired boundary of spatial between the outside and the inside of the building (Kenzari & Elsheshtawy, 2003).

2.6.1.2.4 Aesthetic and Social Role

Although it is not a functional aspect, the mashrabiya also filled a much needed aesthetic role within the Emirati building. A visual counterpoint is required with heavy walls creating a stark and solid impression. The mashrabiya added life and vibrancy by creating new points of aesthetic expression.

The intricacy and delicacy of the screens was the perfect visual contrast towards the functionalist architecture of thermal mass. The aspect of decoration of the mashrabiya becomes a social statement; the more complex and delicate the mashrabiya is, the more highly prized and expensive the worth of the building is.

2.6.1.2.5 Development

Mashrabiya screens were particularly suited to Middle Eastern countries, where the dry hot weather is dominant. It was first introduced as a traditional way to cover openings and windows

for social and climatic reasons, creating a thermal comfort effect inside the space. Later it became a cultural component that reflects special eras through history and an icon which provides local identity for each country.

It was a highly-prized feature in these countries, not only because of its extraordinary versatility and effectiveness at controlling the climate but also because of its delicacy.
Along with the mashrabiya's costly prices and flammable properties, social problems of providing high levels of privacy which became no longer an essential requirement recently, made the mashrabiya not the first solution to cover building facades in modern times. Consequently, mashrabiya experienced a noticeable development revolution regarding its shape, components, and materials that embraced it in a unique way throughout the history.

Mashrabiya, which is considered as a fundamental Islamic unit by which architects innovated creating a distinct design, didn't stand steady only as a passive element but has taken a dramatic approach to address contemporary issues (Abdelkader, Reem & Park, Jin-Ho 2017).

Nowadays, high-rise glazed towers have become the dominant architectural typology for new buildings in the UAE. However, quite obviously, these kinds of buildings are often unsuitable for the arid and desert climates that characterize these countries, although recent developments in computer-aided design programs and digital fabrication have enabled architects to explore new building forms and new treatments of envelopes, in an attempt to solve architectural design problems. It should be noted that while there will be several examples of the adoption of the mashrabiya within double-skin construction, the focus here will primarily be on the way in which the mashrabiya can be integrated within various advanced facade systems.
Al Bahr Towers, Abu Dhabi evolved the idea of a moving culture-oriented façade which was first attempted at the Institute du Monde Arabe in Paris, it has fascinated architects but has never been delivered on any large scale.

Al Bahr Towers represented this technology which has been used on a high-rise buildings scale and opened up a new direction in building designs (Figure: see below). The towers are covered by the mashrabiya cladding system on the south, west and east elevations. The north façade was

designed without installing the shading device as solar heat reaches its minimum in the north orientation.

In this, the mashrabiya façade system suggested an efficient solution to the climatic condition of the UAE, besides improving the environmental performance through utilizing modern technology to meet higher standards of energy efficiency. Al Bahr Towers fused the principles of vernacular architecture through integrating mashrabiya geometry derived from Islamic composition into a total responsive façade system, and performance through using parametric and algorithmic computer studies (Figure 2.59) to come up with an efficient energy integrating system (Abdelkader & Reem & Jin-Ho 2017).

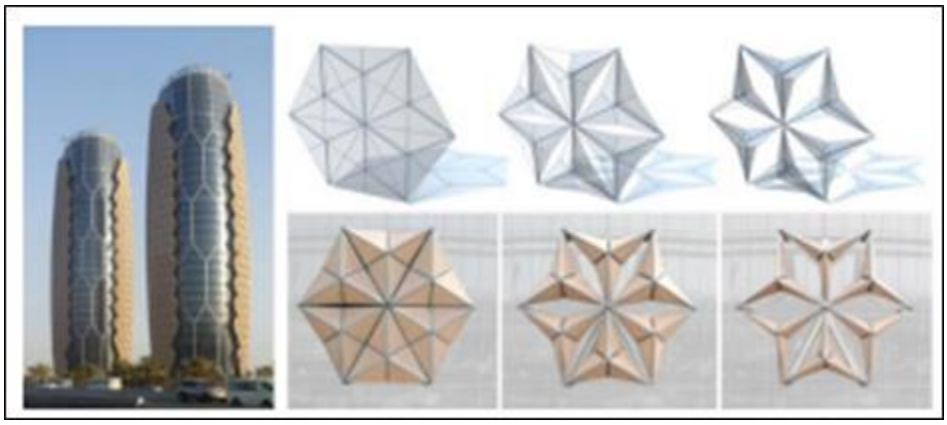

Figure 2.59: Al Bahr towers, Abu Dhabi
Source: ctbuh.org, 2013

2.6.2 The Wind Tower (Barjeel)

The wind tower (translated as badgir in Persian and barjeel in Arabic) (Figure 2.60). It has been used for many centuries and is considered as a traditional architectural element, not only in the United Arab Emirates but along the Arab Gulf, the Middle East and in parts of Asia. Its main function is to create ventilation in structures. There is no record as to who invented it first, though its influence had spread to countries and continents. Today, the design of the wind tower varies from uni- and multi-directional. In areas of the Middle East, Afghanistan and Pakistan, the wind tower has been a traditional element of architecture.

Figure 2.60: Wind towers in the skyline of Dubai
Source: TripAdvisor, 2017

The countries of the Middle East have extreme day and night temperature variations. The air has a tendency to be very dry all day long. Thus the construction of most buildings is composed of very thick walls (Al-Hassani, 2014). In addition, there is a tendency in town centres and desert oases to be packed adjacently together with high walls and ceilings, hence maximizing shade at ground level.

Direct sunlight is minimized, with small windows that do not face the sun (Bahadori, 1978). Houses are cooled by a symbolic and traditional form of air-conditioning called wind towers. As the name implies, this element traps breezes coming from the mountains and leads them into the courtyard and house (Figure 2.61). They chase away the warm air like chimneys on the other side and maintain steady ventilation and fresh cold air in the building (Al-Hassani, 2005).

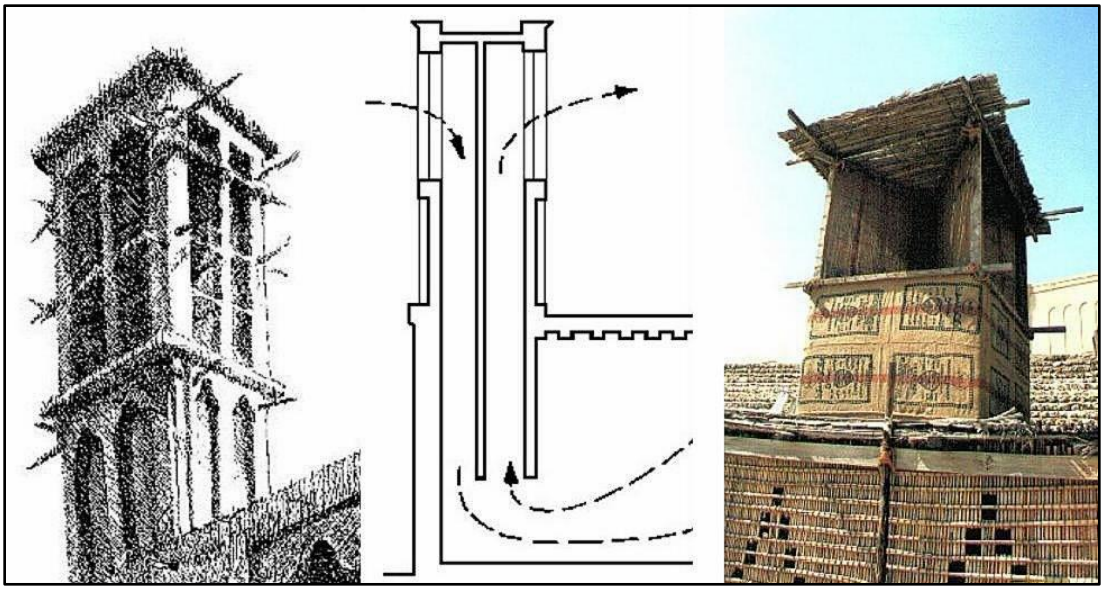

Figure 2.61: Traditional wind towers in the United Arab Emirates
Source: Al-Hassani, 2005

2.6.2.1 History of the Wind Tower

In the past, the wind tower was constructed in different forms and shapes in various parts of the world. They all have the same function. The wind tower can be defined as a traditional structure and its main purpose is to facilitate ventilation, despite different names given to it across the Middle East, central Asia and north Africa (Bahadori, 1985). The primary idea of the wind tower can be seen in the tribal society tents of the Middle East.

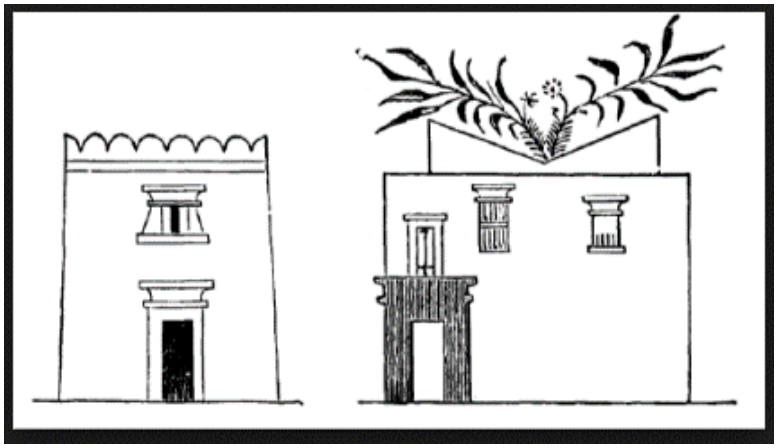

Figure 2.62: Image of Egyptian 'wind tower' of Nebamun's tomb
Source: Commons.wikimedia.org, 2009.

The Bedouin tents in Sri Lanka with their simple pores can be considered as the initial concept of the wind tower. According to the structure of the tent, the weight of the tent is being supported by a piece of wood that is projecting while the tent is standing, and its side facing the wind is closed; there is an opening at the top which allows the airflow to be directed to the tent's centre (Roaf, 1982).

Researchers such as Shorbagy made great efforts to assign to Egypt the history of the beginning of the wind tower (Figure 2.62) on the basis of the images found in Tal el Amarna from the tombs of Egyptian Pharaohs (Roaf, 1982).

These elements are the same stairs directing towards the roof, but in a certain manner, the angular roof meets the outside walls which makes it to be more likely to be a wind tower (Mahmoudi, 2007).

Shorbagy termed the wind tower as "*malqaf*" and suggested that the successful models of wind towers can be found in the Middle East, India and Pakistan, which signified that there is an influence of Persian architecture in these regions. Shorbagy noted that an alteration was made in architecture in the 12th century in houses in the Mamluk Sultanate and they covered the top yard and consequently termed it as "*qa'ah"*, an Arabic term for hall. It is usually a space that consisted of a central region with ceilings that are high and two balconies. The malqaf was invented by vernacular architects for the purpose of ventilation and it was situated in the northern side of the qa'ah and at the highest end of the roof. The wind can be directed by the malqaf into the qa'ah in a particular direction. The size of the malqaf is reliant on the outside temperature of the air and the more the temperature had risen, the more the size of the malqaf will decrease.

2.6.2.2 Features

Traditional wind towers were square on plan and exhibit X-configuration interior plans. They were constructed around wooden armature poles (Figure 2.63), which were reinforced to stabilize the structure.

Figure 2.63: Traditional wind towers
Source:Al-Hassani, 2005

In the UAE, the element that functions as building ventilation reinforcing the plain walls is the wind tower. As discussed before, the wind tower is a type of structure which allows air to be channelled into buildings with the purpose of ventilating the enclosed internal spaces.

In dense urban locations where it is necessary to draw compact air down into courtyard houses, the wind towers are used. There would be no possibility of taking advantage of the prevailing breezes and winds without the construction of such towers, either from the "Shamal", a name for the northern wind, or from the on- and off-shore breezes (Figure 2.64).

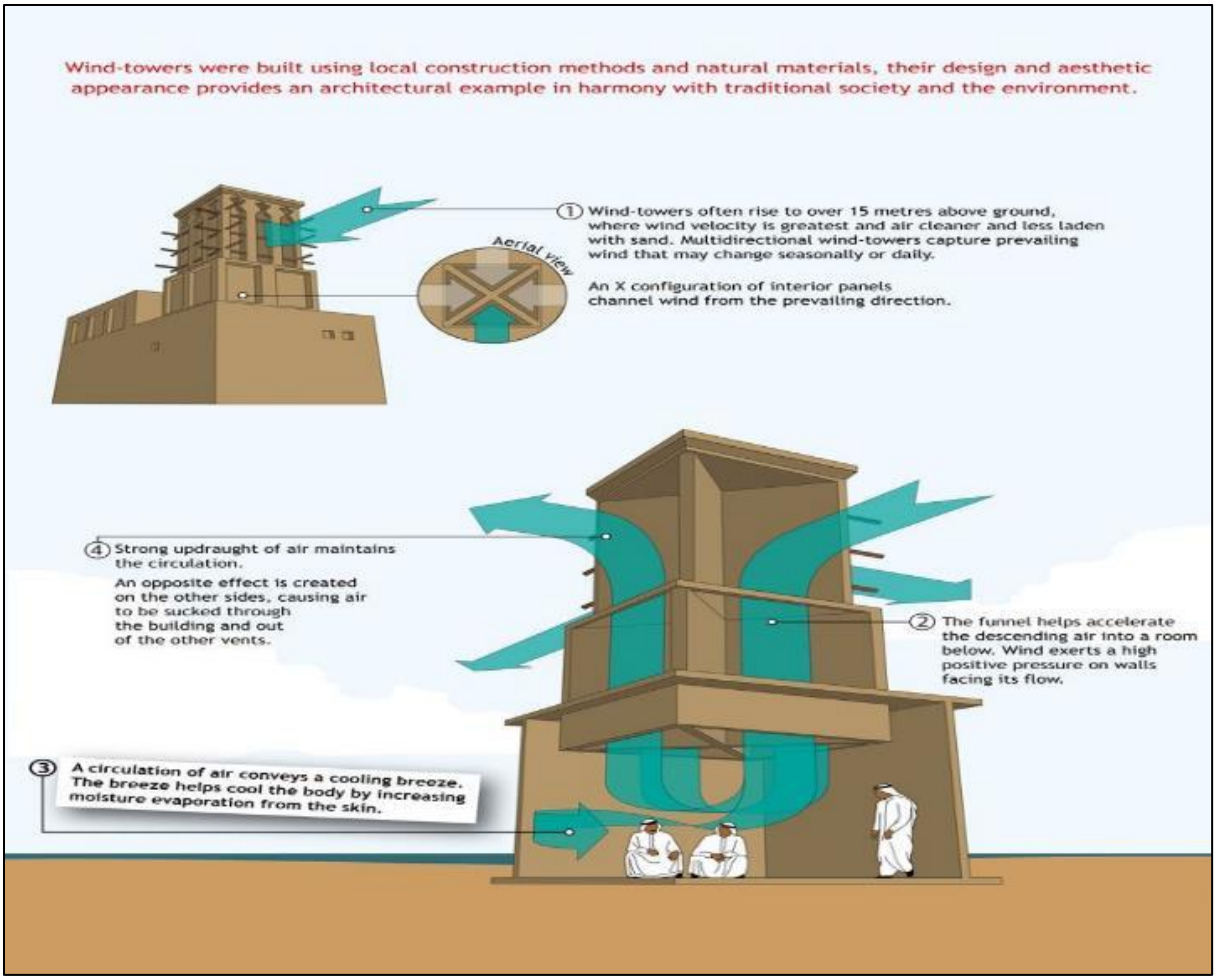

Figure 2.64: Schematic diagram of a wind tower
Source: Goumbook, 2012

2.6.2.3 Types of Wind Towers

2.6.2.3.1 One-sided Wind Towers

In regions where the air is blowing in one specified direction, one-sided wind towers were used. To induce air directly inside the house, it only has one duct or passage that is facing the wind direction. To catch the prevailing wind, it is usually designed with a higher tower as the air in higher elevations is cooler and dust-free. As this air is necessary to exit rooms, segments are used for exhausts which require doors and windows (Figure 2.65).

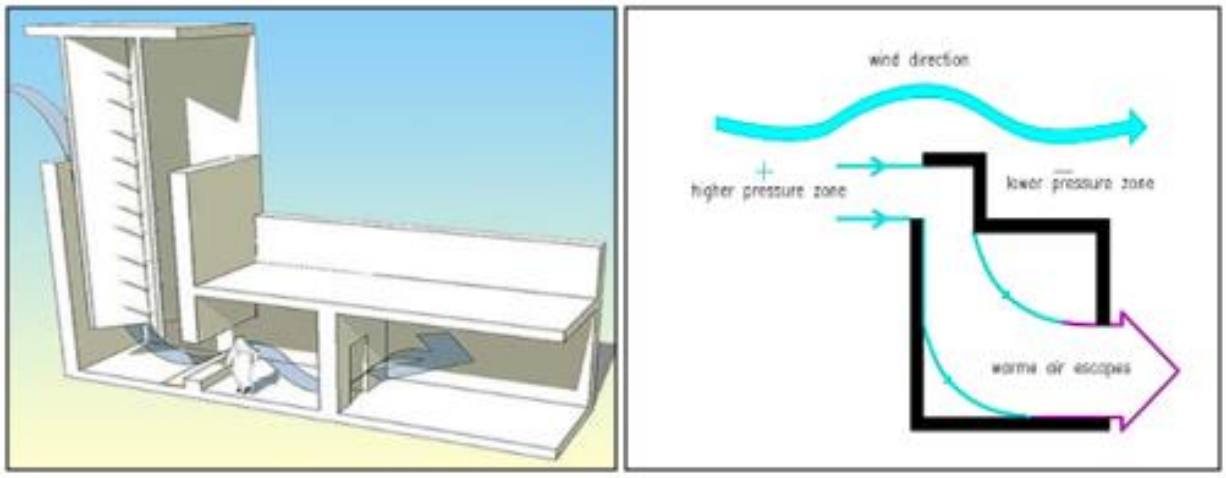

Figure 2.65: Cross-section graph of a one-sided wind tower showing air movement by pressure differential
Source: Montazeri, 2010

2.6.2.3.2 Two-sided Wind Towers

The two-sided wind tower possesses a shaft with the top opening on two sides that are opposing, and a dividing panel that goes through the length of the shaft to direct the cool air in a downward direction towards the area of seating. In this kind of wind tower, the air enters the room from one side, ventilating the room and escaping towards the other side (Figure 2.66).

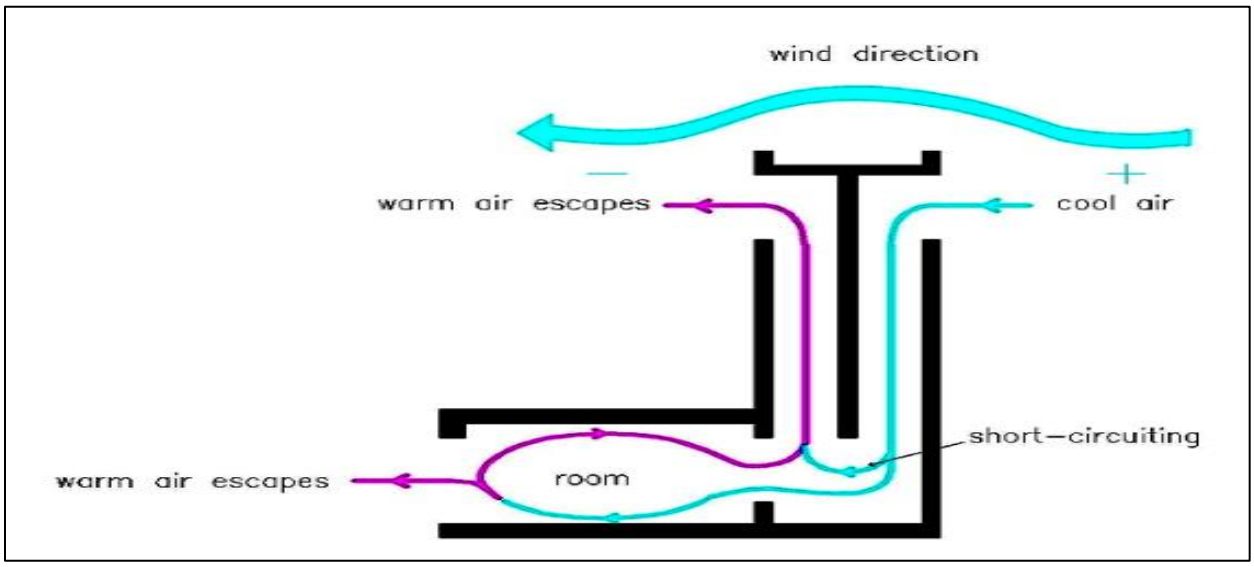

Figure 2.66: Cross-section of a two-sided wind tower
Source: Montazeri, 2010

2.6.2.3.3 Three-sided Wind Towers

With the three-sided wind tower, the windward side is usually larger to catch the most of the predominant winds. As the air enters through the curved shape of the inside outlets, the wind speed increases. In the town of Tabas, Iran, this kind of wind tower is very prevalent (Figure 2.67).

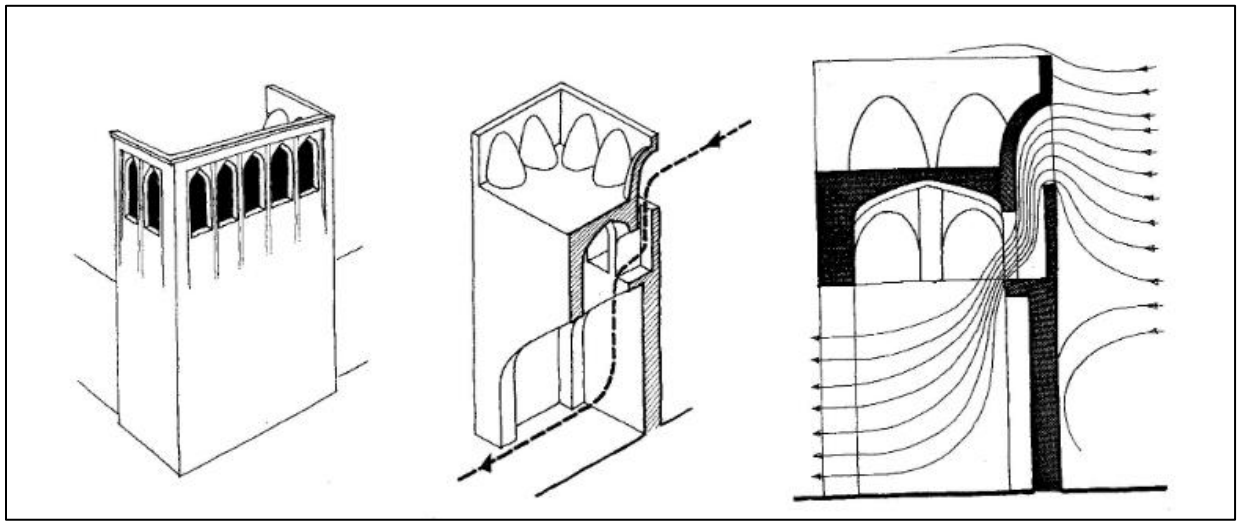

Figure 2.67: Cross-section of a three-sided wind tower
Source: Montazeri, 2010

2.6.2.4 Orientation and Function of a Wind Tower

The wind tower's direction in general implies the wind tower's flank position on the basis of the four main geographical directions. It is determined by the use of wind, view of function and the desired direction in which the wind blows.

One-directional wind towers are positioned to face the desired wind and are most common in Meibod, Iran (Dehnavi et al., 2001).

In Yazd, Iran, desirable wind currents blow from the direction of northwest; hence the long sides of wind towers are positioned northwest for optimal usage of the wind to ventilate buildings.

Wind towers have an east-west orientation in coastal regions like Bandar Lengeh, Iran, where the sea breezes flow east to west during night and day. In order to use all of the desirable winds from north to south, wind towers were also built with four-directional orientation from north to south as well as east to west (Dehnavi et al., 2001).

In Emirati architecture, this kind of structure is considered as a formal structural element that conveys wind flow towards the internal building spaces so that thermal comfort can be achieved. Ventilation for the building was provided for by a tunnel that is linked to the wind tower, while at the same time it serves as a conduit in itself through which the stuffiness within the building is transported out through the shaft of the wind tower.

Different shapes and functions of wind towers were constructed for different climates (Ghaemmagham & Mahmoudi, 2005). It is evident that the wind tower is leaning towards the architecture of the UAE where mangrove poles on the inside of the tower provided a built-in natural ladder for repair, maintenance and access (Figure 2.68). Mangrove poles are also found in structural beams and in the inside walls to ensure a strong bonding of corners, to have a safe platform for new construction and refurbishment, and in conjunction with the internal ladder would have provided safe access.

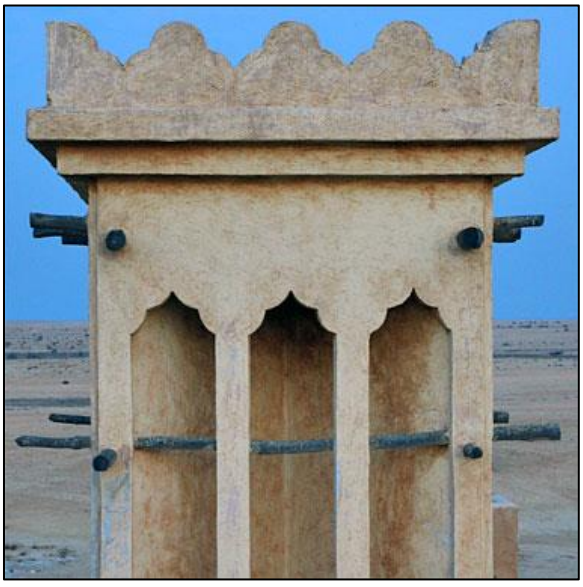

Figure 2.68: Variant design of the wind tower in the UAE
Source: Al –Zubaidi, 2007

The isometric diagram (Figure 2.69) illustrates the relationship of the wind tower with other structures and elements of a traditional Emirati house.

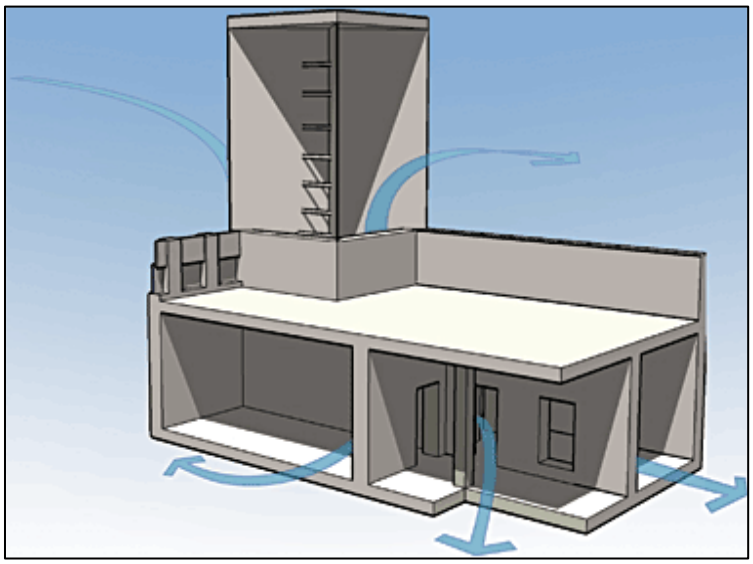

Figure 2.69: Airflow from wind tower
Source: Montazeri, 2010

In Figure 2.69, the emphasis is on the interior of the bottom of the tower, that acts as a distribution duct for the volume of air as well as a place that served as a depository area for any sand or dust that might be carried along by the winds. This was achieved by the provision of a small step, generally around 150-300mm in height and which caught the heavier grains of sand. The top of the opening between the distribution room and the tower was generally low at about 1500mm; hence the velocity of the penetrating wind was being increased.

The openings might be considered and used as a conditioner and filter by employing scrub stuffed into the opening and watered constantly.

2.6.2.5 Development

The wind tower is a traditional architectural element of UAE houses. Although at present the wind tower is not a need because most people have modern air-conditioning, it is considered as

an element of local identity that could be seen in contemporary buildings like villas and government buildings as an aesthetic architectural element.

A widely-practised approach to hybridization in the UAE and other Gulf States has been to apply a veneer of vernacular architecture to modern buildings, most notably by positioning wind towers on their structures.
Wind towers rise from hotels, shopping malls, mosques, and residential developments. While they pay homage to the heritage of traditional architecture, these wind towers are non-functional.

Perhaps the best example of this cut-and-paste architectural symbolism is Dubai's resort of Medinet Jumeirah (Figure 2.70), bristling with non-functioning wind towers, while it is touted by its agents as an "authentic recreation of ancient Arabia, capturing the natural beauty of the region" (Ardalan, 2010).

Figure 2.70: Medinet Jumeirah wind towers, Dubai
Source: Gulf News, 2016

2.6.3 The Courtyard

The courtyard is the most significant element symbolizing the core of all Emirati houses. The concept of the courtyard is normally employed in traditional Emirati architecture, both in urban and rural areas (Figure 2.71); used generally amongst the hot and arid areas. It has been

suggested that the real origin of the courtyard dates back to 1900 BC, to the traditions of the ancient Greeks and Romans.

Figure 2.71: An old Emirati house with courtyard
Source: wellknownplaces.com, 2013

With the emergence of Islam in 632, the concept of the courtyard was adopted by Muslims as it suited their social and religious needs, most particularly their need for privacy.

The arrangement of the courtyard also provided a solution to the harsh climate. Courtyards vary immensely, in size and number depending upon resources and space (Louw, 1983).

The plans below are from two different Middle Eastern countries: Al-Fustate House, Egypt (Figure 2.72) and The Dar Lajimi house, Tunisia (Figure 2.73); houses in the UAE share the same representation of courtyards in relation to the main house.

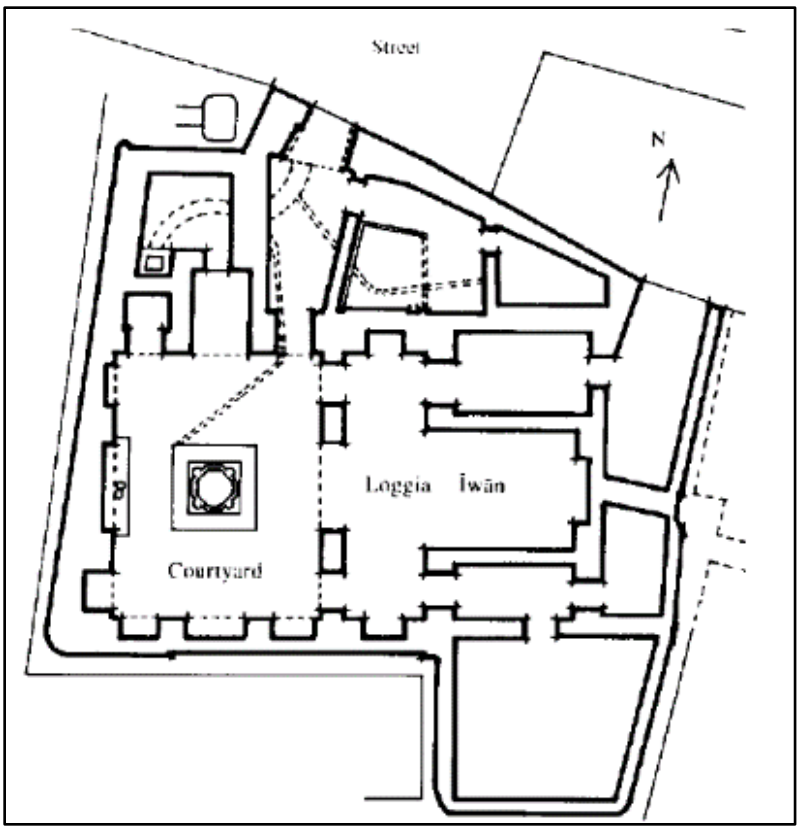

Figure 2.72: Plan of the Al-Fustāt house, Cairo, showing the courtyard
Source: Al-Fathy, 1986.

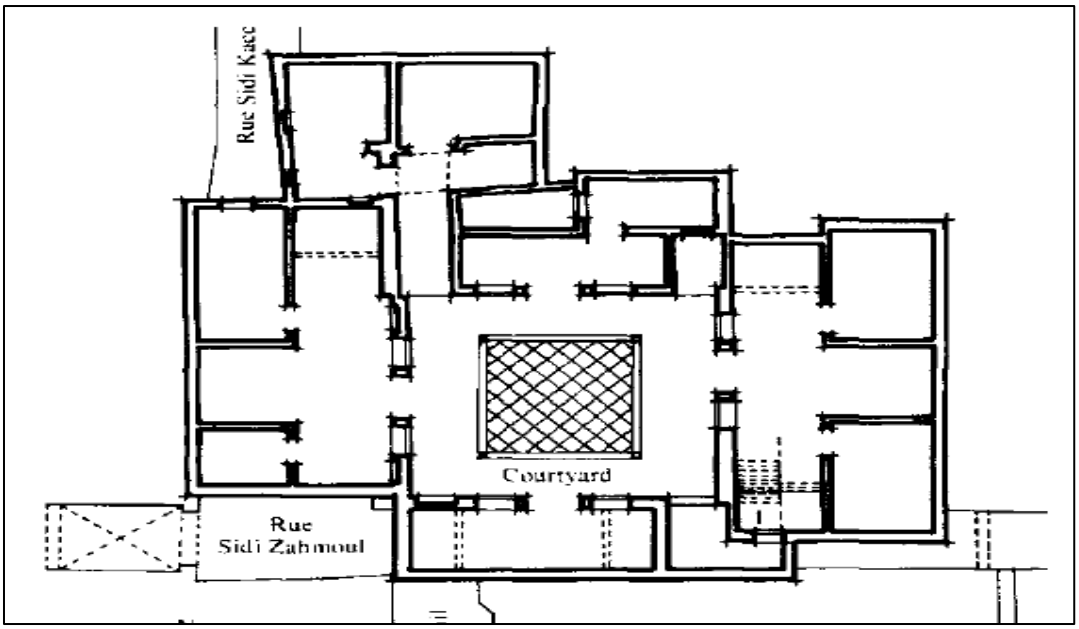

Figure 2.73: Land of Dar Lajimi, a courtyard house, Tunisia
Source: Al-Fathy, 1986

2.6.3.1 History of the Courtyard

Throughout history all over the world, internal or enclosed courtyards have been widely used and even more so in the UAE, with its arid and semi-arid areas. The courtyard has evolved as an important part of the building and urban typologies. Up to the contemporary period, courtyard houses can be seen from the Bronze Age to the Classical, Hellenistic and Roman ages. According to Meir et al. (1995), the courtyard has various forms, detailed treatments and dimensions; however, it serves a single purpose of establishing an open space. According to Petruccioli (2004), courtyards vary from Spain, China and Morocco in terms of hierarchy, size and composition of space (Figure 2.74).

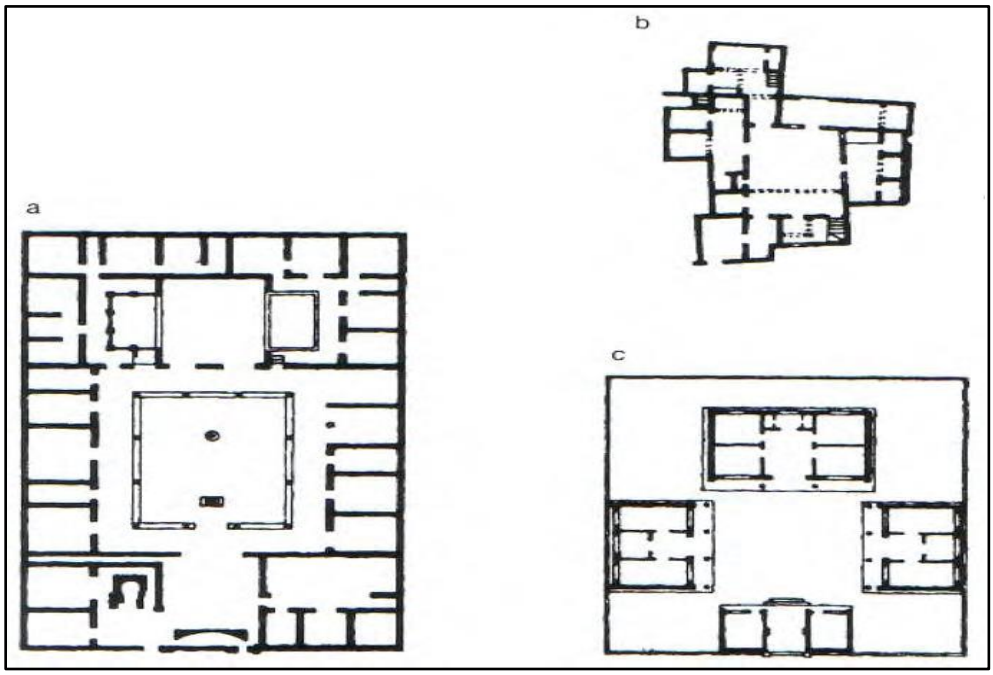

Figure 2.74: Three examples of courtyard houses: (a) Spain. (b)Morocco, (c) China
Source: Petruccioli 2004.

2.6.3.2 Courtyards in Islamic Culture

There is evidence of courtyards being used in Iran, 8000 years ago. In Mesopotamian civilization, the courtyard was an important architectural element, and there has always been a strong relationship between the courtyard and the house.

Memarian and Brown (2004) described that the Middle East is situated principally in hot-arid zones, and in order to decrease the gains of heat of the outer walls, the tendency was to have a close group of buildings, narrow street, roads and small enclosed courtyards in order for shade and cool breeze to be maximized. Within the countries in the Middle East, the courtyards have differences in proportions, sizes and counts although they share the basic concept of locating the courtyards in the centre of the structures (Figure 2.75).

Figure 2.75: Different types of courtyards
Source: Sibley 2004

Security and privacy are provided in the courtyard for the inhabitants as well as protection from the wind, sun, dust and daylight for the rooms which were constructed around them. A pleasant space was established for the residents during the hot summer months by way of putting a water element in the centre and planting vegetation (Safarzadeh & Bahadori, 2005). It should be noted that the role of the courtyard varies between different regions. Various functions can be performed in the courtyard, such as defining a place of privacy for the family, demarcating the limit of property, unifying the elements and spaces of the house, providing a circular element, promoting ventilation and enhancing thermal comfort (Figure 2.76). These various functions can be separately treated or combined together (Memarian & Brown, 2004).

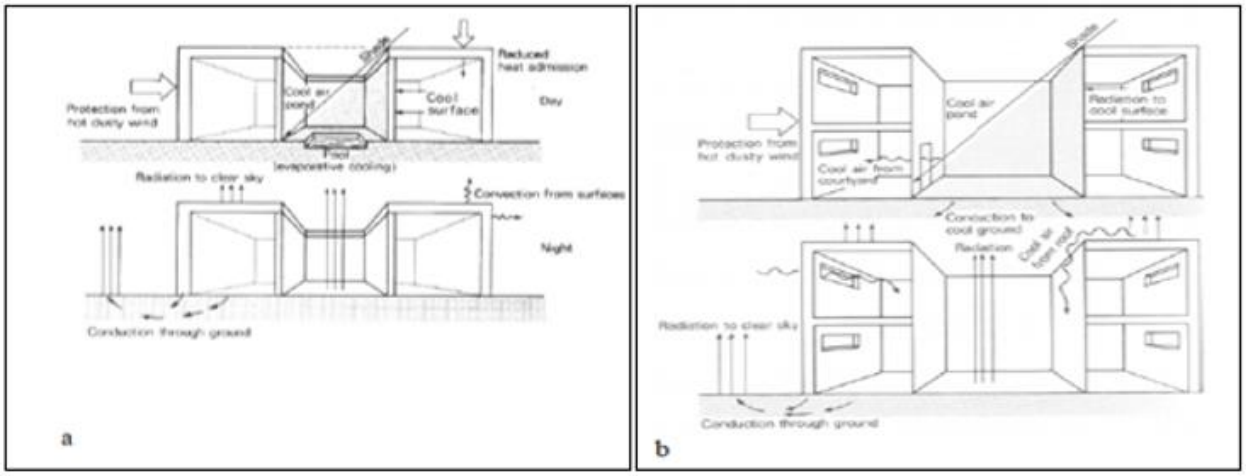

Figure 2.76: The thermal system of (a) small and (b) large courtyard houses
Source: Koenigsberger et al. 1980

In wealthy households, there were two distinct courtyards – one for the private quarters and one for the reception area. Most houses are comprised of one internal courtyard and private quarters situated as far as possible from the reception areas and entrances. There were usually no openings towards the street so, where openings were required, they would be situated above eye-level to avoid the looks of strangers. A view of the private areas of a house from the entrance is not permitted in traditional Arab courtyard houses.

2.6.3.3 Orientation of the Courtyard

Geometry played a decisive role within the thermals, even though the average temperature difference between west-facing and south-facing courtyards was small. The patterns of cooling and heating of the open spaces varied according to the radiation coming from the sun and the direction of the wind (Meir & Pearlmutter, 1995). When all sidewalls are at the same height, orientation has very little effect on the quantity of solar radiation entering the courtyard. There was a greater influence of orientation when the courtyard was elongated.

2.6.3.4 Water Elements

Throughout history, in many different regions, employing fountains and pools in courtyards was very common. The water element was usually situated at the centre of the courtyard (Figure 2.77). During the hot summer months, air temperature was decreased by evaporating and storing heat, establishing a 'heat sink'. Water was used as a physical and psychological cooling aid.

Figure 2.77: The classic courtyard
Source: Bukhash,2000

2.6.3.5 Development

Nowadays, courtyards do still exist in UAE architecture; environmental and social needs were the most desirable traits in housing, which has led to the usage of the courtyard in architecture and landscaping, though the purposes of using it have varied over time.

The courtyard has fallen somewhat from favour in recent decades in the UAE, as the country has become influenced by foreign design styles that are far less suited to the weather and culture of this region.

There are some contemporary building examples of the courtyard in the UAE, such as Bab Al Shams hotel and resort, Dubai (Figure 2.78) and The One&Only Royal Mirage hotel, Dubai,

both of which include striking examples of courtyard-style spaces. The Souq Madinat Jumeirah also features internal courtyards within its labyrinthine setting of shops and restaurants.

Figure 2.78: Bab Alshams courtyard
Source: sassymamadubai.com, 2017

A reliable example of the developed courtyard is the Sheikh Zayed Grand Mosque, which has become one of the most famous tourist attractions in Abu Dhabi. The mosque was built between 1996 and 2007 and was designed by Yosef Abdelki. It was designed to implement the Islamic elements within the structure to give the city a landmark that bears a signature of the Islamic-Arabic culture.

The mosque has a 17,000 square metre courtyard (Figure 2.79) with 1048 columns that is surrounded by all the different zones of the mosque (Figure 2.80). This courtyard is an example of how the heritage elements can be adapted in a contemporary building (abudhabi.ae, 2016).

Figure 2.79: Courtyard view of Sheikh Zayed Grand Mosque
Source: abudhabimosque.com

Figure 2.80: Top view of Sheikh Zayed Grand Mosque
Source: abudhabimosque.com

New UAE architecture aspires to modernity, cutting-edge technology, sumptuous detail, stunning views and ultimate privacy. It manages this in no small part by embracing an architectural style that was invented in the Middle East decades ago, combining the old and the new in a type of housing that is ideal for the desert environment which can be achieved by enhancing and developing the heritage elements such as the courtyard.

Thus lately they have been used more for traditional purposes, especially with a sustainable buildings, compounds and cities vibe, that has been vital initially for any modern city to be developed in an eco-friendly way. This has increased by increasing awareness towards the environment and by the fast development, which has been accelerating in the past five decades.

2.6.4 The Broken Entrance

In the Arab world generally and in particular the Emirates, the entrance to the house is a broken entrance which is open towards the courtyard. In order to obstruct views into the inside of the house, the broken entrance was designed to open onto a blank wall that creates privacy. Figure 2.81 shows the relationship of the main entrance towards the courtyard.

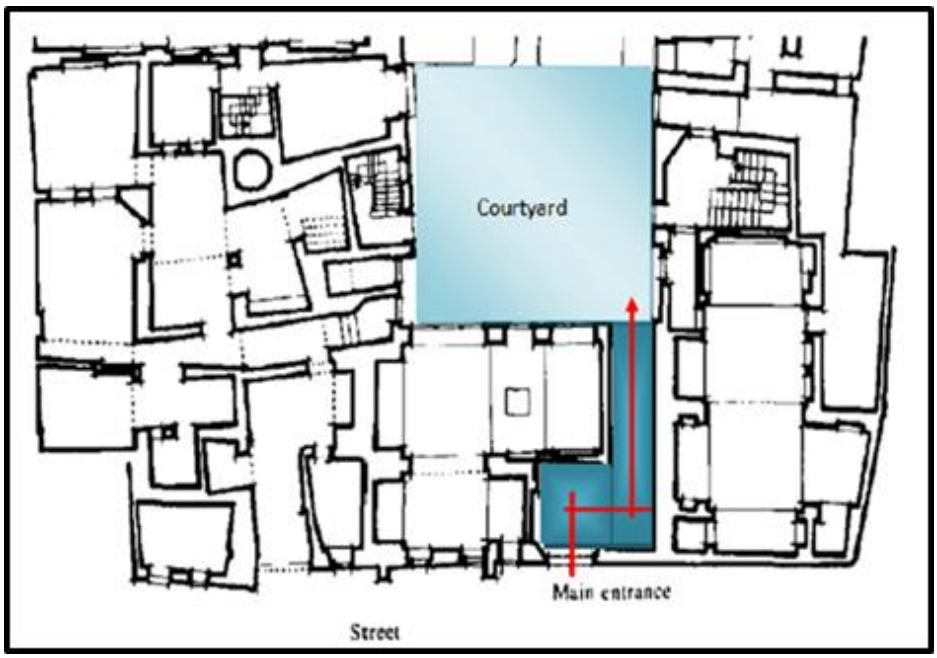

Figure 2.81: The broken entrance
Source: Cook, 2000

As shown in Figure 2.81, the main entrance has a broken wall which provides much privacy from outsiders towards the inner areas of the house, a technique which is much required in the UAE's community due to the Islamic and Arabic background of its residents.

The users of the house, and females in particular, should have a comfortable private house space that is completely isolated from external eyes, and this is provided by breaking the straight wall that leads to the courtyard with another wall, together creating an L-shaped wall.

In many Arabian countries, a broken entrance was widely used and in the early days of the function of the broken entrance, it served as a defence element.
In Iran, for example, it was later used to ensure that the courtyard and the related internal space had privacy (Memarian & Brown, 2004).

Figure 2.82 shows a house with a courtyard in Iran in which the residents of the house are enabled by a broken entrance to retain their privacy of the courtyard space.

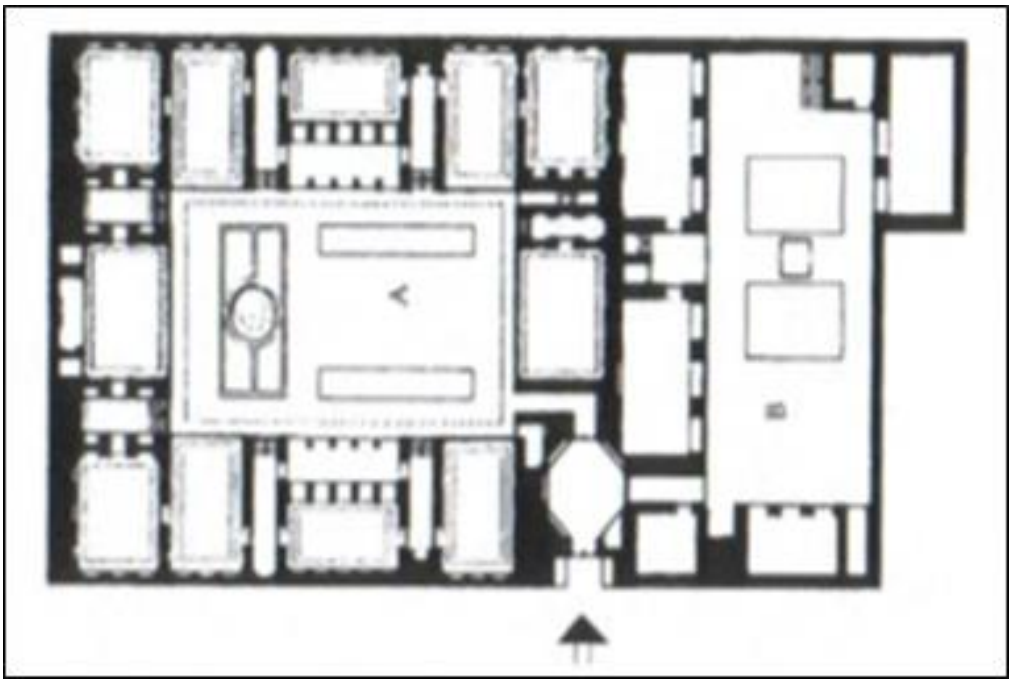

Figure 2.82: Courtyard house in Shiraz, Iran, with a broken entrance
Source: Memarian and Brown, 2004

The development of this element is found in private and public facilities, such as washrooms and facility offices in shopping malls, which have an L-shaped wall directly after the entrance door to keep the inside space visually isolated from users.

To achieve the concept of maintaining high privacy levels, a space has been developed to structure two different entrances for female and male users, to prevent any contact with foreigners, which is not desirable in Emirati society.

2.7 Summary

To sum up, traditional buildings in a particular community are considered the most suitable way of life for its own people. It has been made and developed out of local, available and sustainable materials and matching its context, whether climatic, social or even economic.
In their path to modernity, most developing countries have dropped their history and traditional products to import those created and developed from the west, inserting them in a totally unmatched environment.

That insertion creates separation between individuals and their built environment of the most intimate spaces, in addition to the high cost of related services and systems needed to overcome the differences between inserted buildings and their natural context.

UAE in general has its own heritage and traditional buildings which were created originally from available material and matched the regional context. Rather, it has never been developed to match the progressive needs of the community. These buildings, while producing a sustainable environment and social context can be developed in a manner to provide a sustainable response to the progressive needs of modernity and to save the signature of the country as well.

This chapter explained where Emirati architecture stands nowadays, as well as identifying the Emirati heritage building elements, in addition to declaring the value of heritage elements and the importance of preserving them, and gave reliable examples of heritage elements implemented in contemporary buildings.

These elements will be the factors to evaluate any of the upcoming case studies, their existence, their uses, and how reliable they are in contemporary building techniques.

The four main elements chosen for this research are as follows:

- The mashrabiya
- The wind tower
- The courtyard
- The broken entrance

Chapter 3
Planning the Research Methodology, Philosophy and Framework

3.1 Introduction

Architectural research has been defined by the American Institute of Architects as the avid search for new ideas and new knowledge of the built environment and their specification in guidelines. The guidelines will cover a thorough discussion of the various research characteristics, which are as follows:

- Goals are clearly identified in a research
- There must be a relevant methodology that is capable of pursuing the answer and accessible to the domain of the research where it is operating
- Significant results must be the outcome of this methodology that reflects a solution or improves the knowledge and understanding of the domain of the research.

This chapter attempts to explain the reason and logic of why this research methodology as well as the methods of data collection and data analysis will be used in the research's empirical study. This chapter also attempts to identify the characteristics of analysis that will be used as the basis for the comparison of the case study and defines the different characteristics of the present study. Through case study analysis of the façade and the massing and articulation of different building types of the country that either used functional or non-functional architectural heritage elements, it is expected that it will enable guidelines to be made for the preservation of architectural elements as an integral part of contemporary architecture.

3.2 Objectives of Empirical Research

The previous chapter reviewed architectural heritage elements and their development. The main focus of defining the historical origins of architectural elements in this research can be summarized as:

- Identification of the different architectural heritage elements of the UAE has been developed through different cultural and social needs for the inhabitants.
- Recognition of different functions of these architectural heritage elements, as well as the design that supports the lifestyle of the inhabitants.
- The evolution of architectural design that leads to the misuse of these architectural elements in the contemporary period.

This chapter will introduce a framework of analysis that will be used in this research, leading systematically to testing the findings through the case study method of variety of buildings, which rely on different architectural structures. This chapter will focus mainly on the planning of this methodology by first setting out objectives for analysis, which will give a rationale.

Criteria for the investigation of the selected case studies will be determined and identified, as well as the method that will be used in the analysis of the collected data. Figure 3.1 illustrates the process in which the data is collected and analyzed for this research.

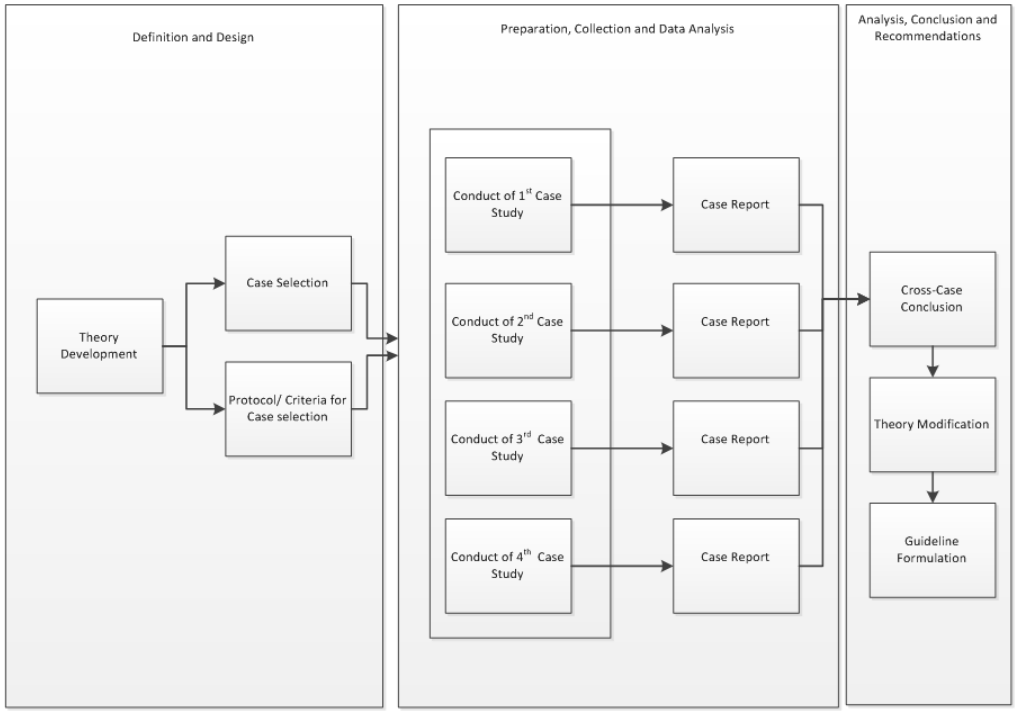

Figure 3.1: Process of collecting and analyzing data

These present empirical were able to identify its specific objectives, which are as follows:

- Testing the CIPP method in regard of its reliability and applicability and its relevance to the final findings of this research.
- Evaluating the heritage elements that are used in contemporary case studies.

With reference to the above-mentioned objectives of the empirical study, the concept plan that explains the main phases and relationships within the research methodology is illustrated in Figure 3.2.

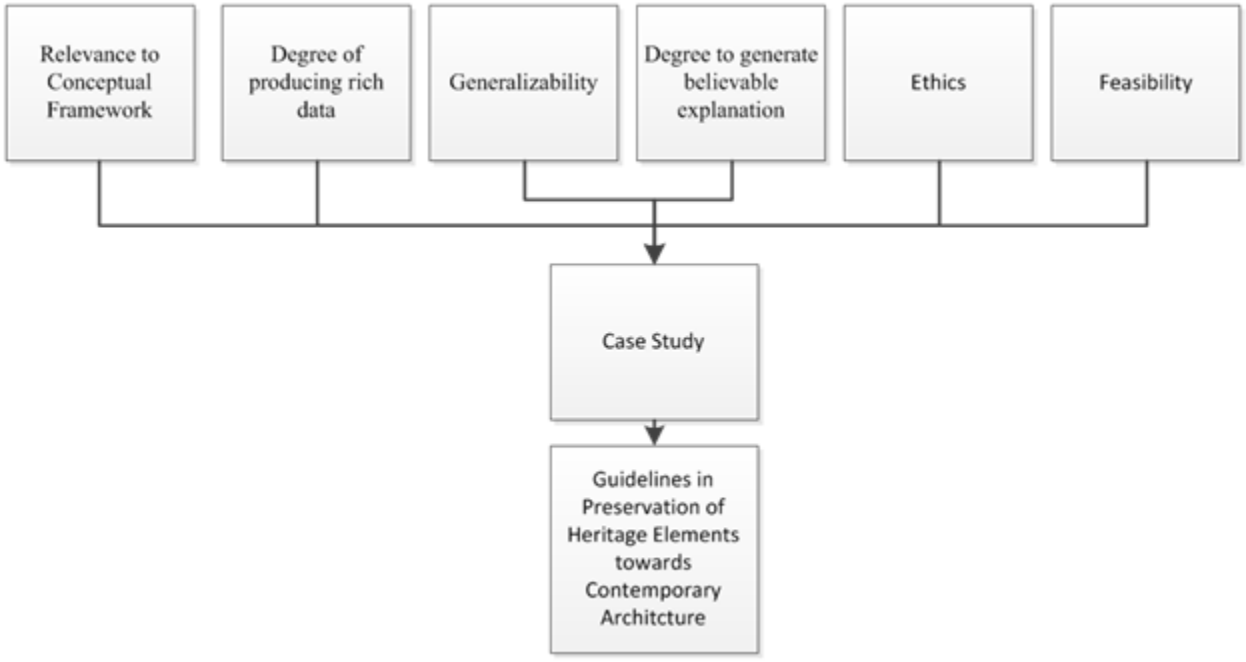

Figure 3.2: Concept map
Source: Miles and Huberman, 1994

3.3 Comparative Analysis as a Research Methodology

As identified by R. Murray Thomas (2003), "the act of comparing things consists of identifying how the chosen things are (similar to) and (different from) each other". The process to derive comparative analysis consists of five steps:

- Choosing the category of objects to be compared (in this research contemporary buildings),

- Identifying which two or more types of objects within that category are to be compared (in this research usage of heritage elements in contemporary buildings),
- Selecting the characteristics of the objects on which the comparison will focus (this research will focus on usage issues of heritage elements),
- Collecting and presenting descriptive information about the status of each object (data are obtained from architectural drawings and site visiting data),
- Offering conclusions about how the objects are alike and/or different. (In this research, conclusions are concerned with the efficiency of the heritage elements used in contemporary buildings.)

In order to fulfill the empirical study objectives, the research will conduct a deep investigation using comparative analysis for the two chosen buildings (Table 3.1 & Table 3.2). At this level, two issues are raised:

- The use of comparative analysis as the research methodology for empirical study.
- The choice of these buildings to be the case studies of this research.

Table 3.1: Comparison sample (1) for mashrabiya in two case study buildings

Mashrabiya		
Comparison aspects	Abu Dhabi Central Market & Central Souq Sharjah	Al Bahr Towers & Masdar institute
Process	Traditional or developed	Traditional or developed
Product	Functional or non-functional	Functional or non-functional

Table 3.2: Comparison sample (2) for wind tower in two case study buildings

Wind Tower (Barjeel)		
Comparison aspects	Central Souq Sharjah (case study 3)	Masdar Institute (case study 4)
Location	Location and count of the element	Location and count of the element
Similarities /differences	Traditional or developed	Traditional or developed
Purpose	Visual, thermal or traditional	
Functionality	Functional or non-functional	Functional or non-functional

3.3.1 Reasons for Choosing Comparative Analysis

Comparative analysis research methodologies have long been used in social studies, especially in cross-cultural studies to identify, analyze and explain similarities and differences across societies (Hantrais, 1995). Comparative analysis methodology has been used for three types of goals: the construction of inferential histories, the development of typologies, and the explication of generalized processes.

Three strategies are used in comparative analysis methodology: illustrative comparison, complete or universe comparison, and sampled-based comparisons (Sarana, 1975). The units of comparison distinguish the comparative methodologies and the particular items or features used to compare the units.

Illustrative comparison is the most common form of comparative analysis and has been employed extensively by theorists. Items are used as examples to explain or exemplify phenomena found in different units. They are chosen for their illustrative value and not systematically selected to be statistically representative. Illustrative comparisons are used in historical reconstructions, and to support interpretations or general assertions.

The second strategy is complete or universe comparison, in which all elements of the domain within the study, defined geographically or topically, form the units of comparison. Comprehensive regional ethnographic surveys and analyses of particular topics employ this approach.

Finally, sampled comparison strategically delimits part of the whole, with the goal of selecting data that are statistically representative of the variations within the whole and are intended as the basis for statistical generalizations. This strategy is most appropriate to this research because samples of buildings will be chosen that are representative of the variations within the whole. Through comparative analysis, the results can be used for solutions generalization.

The nature of this research empirical study, objectives and level of validity led to choosing comparative analysis as the research methodology. However, choosing this methodology is based on specific reasons, as follows:

- This investigation includes testing the application of the proposed CIPP in existing contemporary buildings to evaluate its heritage elements performance. This comparison is essential to evaluate the performance of each type (Charles Ragin, 1989).
- Recognizing and providing a basis for making statements about empirical regularities and for evaluating and interpreting cases relative to practical and theoretical criteria.

It means that the results of comparative analysis are intended to improve the quality and performance of heritage elements in contemporary buildings which leads to the findings of this research.

3.4 Philosophy Underpinning Case Studies

This research shall employ qualitative case studies as an approach towards its research methodology, wherein phenomenon exploration is facilitated within the context using a variety of data sources.

Hence, this methodology allows this present research to have different perspectives into the cases rather than just one perspective, making it more comprehensive towards the analysis. This

present research has the option to consider and use either of two options as a guide towards the proceeding chapters of data collection and analysis: the one proposed by Stake (1995) and Yin (2003; 2012). However, it is noteworthy that both had been seeking a thorough exploration of the topic of interest at hand towards the revelation of the phenomenon through the methods that they employ, which vary but are both worthy of consideration and discussion.

In terms of the philosophical underpinnings that Yin and Stake treated, and how they use the constructivist paradigm as the basis of their approach, the claim of the constructivist is that the truth is relative and that it is dependent on one's perspective. The importance of the subjective human creation of meaning is being recognized in this paradigm; however, what is constructive about it is the notion of objectivity not being rejected. With focus on the circular dynamic tension of object and subject, pluralism is stressed rather than relativism (Miller & Crabtree, 1999).

The premise of a social construction of reality is the basic premise of constructivism (Searle, 1995). The close collaboration between the researcher and the participant (in this case, the contemporary architectural structures under investigation), while at the same time allowing the participants to be able to communicate their stories, is one of the most basic advantages of this approach. Through this open communication between the participants and the researcher, the views of reality can be described vividly by the participants through their different stories by virtue of their perspective and in doing so allow the researcher to view the case in a holistic and comprehensive manner (Robert & Hart, 2015).

3.4.1 Descriptive Versus Exploratory Case Studies

The scope of application of 'the case study' as a methodology is greater, as described above, and it will serve as an exploratory strategy (Bryman, 1974), contradicted with Yin (2012) that there is an epistemological conflict with the assertion towards a pluralistic view that each type of research strategy could be used for all three purposes: exploratory, descriptive and explanatory. As there is little knowledge established in the area of heritage architectural elements in the UAE, descriptive case studies can be considered as exploratory; both the illustrative aspect and

exploratory element may be included in one case study. Hakim (1987) was very clear in the definition of what is a typical or selective case study.

This research will select contemporary architectural structures that have been adopted in one way or another in varying degrees with traditional heritage elements of United Arab Emirates architecture. Selective case studies are the most optimal and suitable approach, since they have the capability to focus on specific areas, so that a thorough understanding of the causalities and consequences of these interactions of the different building elements surrounding the heritage elements in integration within contemporary architecture can be understood.

Between exploratory and descriptive case studies, there is no exclusivity; some of the best case studies are either descriptive and explanatory or descriptive and exploratory (Yin, 2012). Once the body of research evidence has been completed, selective case studies are used to focus on particular issues.
The degree to which the incidents discussed can generalize the value of the case study. The attempt to isolate selected social factors is a more rigorous application of the explanatory case study or processes within the real-life context to provide a test of the existing explanations.

3.4.2 Qualitative Case Studies

Qualitative case studies were used and preferred in this research because it is widely viewed as a useful tool towards the preliminary and exploratory stage as a basis for the development of the more structured tools that are required in experiments and surveys of a research project. Case studies as a research method or strategy had been viewed typically and traditionally as inadequate in rigour and objectivity when contrasted with other methods of social research; this is one of the fundamental bases to note wherein extra caution must be taken in the research design and implementation.

However, case studies are a unique methodology that suits the intent of this research because of its capability to offer insights that cannot be achieved by other methodologies and strategies, despite the scepticism in this approach. Case studies are particularly suitable to new research

areas or where there is inadequacy of existing research theories (Eisenhardt, 1989). This type of work leans more on complementary than incremental theory building from normal science research. In the early stages of research, the former is useful in a topic or when there is a necessity for a fresh perspective while the latter is very useful in later stages of knowledge.

The definition of case study that has been encountered most frequently has merely repeated the types of topic on which case studies can be imposed. In the words of one, for instance, the essence of a case study, the central tendency among all types of case study is an attempt to illuminate a collection or set of decisions responding to questions as to how they were implemented and why they are taken towards a result (Schramm & Mayo, 1971).

"Decisions" are thus the primary focus of case studies as being implied in this definition. "Institutions", "organizations", "individuals", "programmes", "processes" and even "events" are other common cases. However, just citing a particular case is absolutely not sufficient to establish the required definition of a case study as part of a research method. Many of the social science textbooks have not been successful in considering that the case study is a formal method of research at all (Hoaglin et al., 1982).

One common flaw, as has been discussed previously, was the inclusion in the consideration of the case study as part of the stage wherein exploration is being made for some other methods of research, and the case study is just mentioned as a line or two in its texts. Confusing the case study has been considered as another definitional flaw wherein the case study is being mistakenly considered with participant-observation and ethnographies, so that the presumed discussion of the textbooks of a case study was in reality a description of the ethnographic method or of participant-observation as a technique of data collection. A historical overview of the case study in the methodological perspectives of the Americans are the reasons for these statements. A connection was made by Platt between the conduct of life histories (a work of the School of Sociology of Chicago) and social work cases. Platt was able to show the manner of "participant-observation" as it appeared as a technique for data collection, leaving the further definition of any distinctive case study method in suspension. Platt was able to expound that there is dissociation in a definitive manner between the case study strategies from the limited

perspective of only doing participant-observation, or any other type of fieldwork for that matter. For Platt, the case study strategy commences with logic of design, the preferred strategy that should be used when research problems and circumstances are appropriate rather than an ideological commitment to be followed whatever the circumstances.

According to Yin (2003), there are three conditions that exist when a case study should be used:

- The type of questions that must be fielded in the research
- The degree of control of the researcher over the realistic behavioural events
- The degree of focus towards the contemporary as contradictory towards the historical events.

3.4.3 Justification for Case Study as Research Methodology

Case studies are a preferred research methodology due to them being exploratory and inherently respond to research questions that seek explanation rather than experimentation to insights. This research aims to understand the reason and manner of architectural heritage elements in contemporary UAE architecture. It seeks to gather a thorough rationale and logical clarification.

In this research, explanations are being sought so that a comprehensive understanding can be attained. Questions in this research must be "why?" and "how?" architectural heritage has reached a positive or negative standing in a contemporary period, and how strategies are being implemented to ensure that such elements are integrated into the mainstream of contemporary architecture.

Consiing the magnitude and complexity of architectural designs, which are at the request of each client, architect and engineer; guidelines and recommendations for legislation and regulations in regard to preservation of heritage elements strategies can be implemented.

3.4.4 An Epistemological Basis for Case Studies

The methodological merits of the case study as a research methodology have been considered as a pivot of the argument or for any qualitative research methodology.

The underlying philosophical basis for the arguments that collaborates the research strategy validity is provided by an epistemological base, which considers the appropriate foundation for the study of society and its manifestations. With an objectivist, atomistic view of the world and science as a fundamental view of reality, the quantitative research is routinely depicted as connected with the positivist tradition of the natural sciences which can be gathered as the sum of its parts. Based upon replication, objectivity, causation and definition relying on experimentation are the least creation of knowledge.

And yet, it is from an ontological foundation, in contrast with the epistemological foundation of qualitative research commences in which reality is being defined as some sort of projection of imagination. The constitution of knowledge implies that a clear consensus about what comprises a fact is impossible as being promulgated in these different assumptions are as follows: qualitative research is not likely to succeed a justification under the positivist assumption, and it is linked towards a subjective phenomenological epistemological position. The view of the architects under an empiricist/subjective theory is of being the empirical point of departure.

The span of the epistemological spectrum had been occupied by many philosophical schools of thought which had occupied either of these positions with distinguishable polarity. It is less unlikely as a consequence, among the positivists, to resist any options for qualitative research. In a similar manner, one would anticipate distinguishing a variety of statistical methods among the most subjective empiricists.

Bryman (1974) expanded Trow's dictum and argued that most of the research has the position of being intermediate or hybrid, like many of the epistemological positions. Bryman discounted the epistemological basis on the relevance for methodological criteria by pointing out that there is less chance of symmetry between an epistemological position and social research in their associated techniques. Later on, he cited three conditions where the distinction between epistemological and methodological conditions became less apparent:

1. In terms of technique and sensibility, qualitative research offers great flexibility in the matter of design and application. Hence it tends to be more sensitive towards phenomena of the society and its relevant complexities, as compared with quantitative methods, which only offer observable indicators, which are clearer. Therefore, the appropriate combination of sensitivity and observability should be a basis for the choice of the research in order for the research to be responsive to the problem at hand. However, it is cumbersome in terms of the verification of the correctness of the choice if a qualitative research has consent. It will appear that the methodology itself is at fault, as likely as the application itself.

2. As an exploratory strategy of research methodology, qualitative research has a long history. The qualitative research is the best method towards reconnaissance with quantitative method as end in mind, as there are advantages towards quantitative methods as compared with qualitative methods. This is the second circumstance in the most obvious manner where there is inconsistency between the methodological and epistemological perspectives.

3. Some methodological literature has suggested the combination of the methods (others termed it triangulated strategies) offers the best of possibilities for both qualitative and quantitative research. In terms of epistemological, ideological and philosophical assumptions, each represents a unique rather than a simple technique of data gathering. According to Byman (1974) a 1:1 relationship would be much more remarkable than reassuring under such circumstance.

At face value, a consensus must therefore be reached if these conditions are to be rejected where a single research methodology can be tested on its own account (Morgan & Smircich, 1980). Social research cannot be tested on its own. The ceiling of each research methodology is the ontological and epistemological position; though it is best to consider that there is no such thing as a perfect relationship between the expected epistemological position and methodology (Bryman, 1974). The epistemological perspective has no justification that proves the case study

as being a superior method, though it is best to recognize the capability and merits of this method. The systematic approach of the 'case study' and the soundness of methodology, execution, analysis and design justify the 'case study' as a valid form of strategy in this research.

3.4.5 Reasons for Choosing Case Studies

Case study methodology is of the utmost importance in architectural research. Case study methodology is characterized by a purposeful selection of the case to study, which is normally conducted by means of multiple-method data collection. Generalizations are made from a particular case in the interest either of theory or of other cases. In the field of architecture, the case may be an artifact. Understanding of an artifact often requires knowledge, not only of its contemporary setting, but also of the historical context of its design (Johansson, 2003).

A case study is expected to capture the complexity of a single case. Architecture case studies provide consistent standards to document architecture specifications for the planning, management, communication and execution of activities related to system development (Tang, Han & Pin, 2004).

To attain the objectives of the empirical study, a comparative analysis will be conducted using case studies of contemporary buildings in the UAE.

3.5 Sampling

3.5.1 Principles of Sampling

Case selection, as it has been argued for some types of qualitative research, is not a matter for which principles can be laid down, since in the research question, cases are simply "given". Stake (1994) for instance, in the discussion that was presented concerning case study methodology, was able to differentiate between intrinsic case work, wherein the cases are chosen rather than pre-specified, because the research question focused on a particular case and

instrumental or collective casework, wherein cases are required to be chosen from one or more cases from a number of possible alternatives so that a research theme may be explored.

If qualitative research cases necessitate a choice, as suggested by Stake (1994), "...nothing is more important than making a proper selection of cases. It is a sampling problem" (Stake, 1994). In respect to 'within-case' sampling, there may be issues of selection and choice to be resolved, even in intrinsic casework. Sampling decisions are still important though the researcher is faced with different accounts of the principles of case selection. Reflecting the various perspectives of experts in qualitative research methods, there is less agreement on what qualitative sampling should be.

In the tension between those who espouse a rather pure type of theoretical sampling, this variation of views is particularly obvious between those who espoused a rather pure type of theoretical sampling structured towards creation of a theory that is grounded in the data rather than in fieldwork (Strauss & Corbin, 1990; Glaser & Straus, 1967) in contrast to forms of purposive sampling in which qualitative research fits, which is informed by an existing body of social priority that may become a basis for qualitative research such as the argument of Miles and Huberman (1994).

3.5.2 Strategy of Sampling

For drawing qualitative samples, there are different strategies that have been used (Patton, 1990) and this makes it difficult to draw out the conceptual principle, which might be of general relevance, which the literature above has refined:

- The theory of statistical probability of selection is not the basis of the method of drawing samples but on other sampling criteria that are purposive or theoretical in nature.
- Samples are less in quantity, which is intensively studied to produce a large volume of information.
- There is no definite pre-specification of the samples; there is a sequence in the selection process.

- The selection of the sample is conceptually driven either by an evolving theory which is inductively derived from the proceeds of the research data, or by theoretical framework which underpins the research question from the outset.
- There must be a reflection and explicitness about the case selection rationale by the qualitative research.
- Analytic generalizations are the results which qualitative samples are designed to produce (on the basis of how selected cases fit with general constructs, it is applied to a wider theory) but not on a statistical generalization. Miles and Huberman (1994) contend that the opportunity to examine and select observations of generic processes can be provided by qualitative sampling, and are key towards the understanding of a new or current theory about the presently studied phenomenon. The selection of these cases implies that the theory will drive such process, besides which the careful evaluation of the cases may result in the expounding or reformulation of theory.

The researcher was inclined to investigate the extent to which such principles of qualitative sampling might be articulated in the substance of guidelines that can be used in the evaluation of alternative strategies of sampling in research. Moreover, it is with awareness that the notion of general guidelines may seem an abhorrence to some researchers who feel that the nature of qualitative research is idiographic and not amendable to evaluate against any common principles. It is contended that there is significance as well as justification in qualitative case study research rigour, and that it is difficult to do without some discussion of what aspects of sampling may be important and agreed. Existing relevant criteria that are aimed at the evaluation of qualitative case study sampling are useful to generate the content. Miles and Huberman (1994) proposed a set of criteria that can be evaluated by way of seven different attributes that are presented in an approach that is educational in a checklist form. The following are the seven interpretation criteria set by Miles and Huberman:

- There must be relevance between the conceptual framework, sampling strategy and the research question. Considerations to whether sampling is intended to provide cases in categories according to the relevance towards a pre-existing conceptual research

framework or the degree of choice of case might affect the scope for theory development from the data inductively.

- The information must be generated from the sample of the type of phenomena, which is required to be studied. This is termed as whether in the research the phenomena of interest have a probability to appear in the observation (Miles & Huberman, 1994). The collation of "thick description" of the phenomena is being relied on by the intensive research which is important in a conceptual sense, so that in this research it will be argued that there is significance for the cases to provide rich information in the UAE's architectural heritage elements in contemporary times.

- The general findings should be enhanced by the sample. This research is very keen on analytic generalizations rather than statistical power in statement generation on the basis of a sample towards a general population.

- Believable descriptions/explanations must be produced by the sample. Whether it produces an absolutely convincing explanation and/or an account of what is being observed, it will validate the qualitative research.

- Reliability of source information may be raised as an issue of criteria of bias or completeness.

- Whether the method of selection permits informed consent where it is necessary, Miles and Huberman (1994) suggested that it must be considered by the researcher whether the ethical nature of the relationship between informant, researcher and the risks and/or benefits that are associated with selection for and participation in the study.

- It is encouraged by Miles and Huberman (1994) that the researcher has to consider feasibility in terms of the cost of resources: money, time, pragmatic issues such as accessibility and compatibility of the work style of the researcher and the sampling strategy. It is believed that it should also include competence, the skills of the researcher

in terms of language and communication and the ability to relate to the experiences of the informants plus the researcher's ability to organize and analyze data.

This checklist had been designed as a relative explicit articulation of how to assess purposive sampling as a strategy that is being chosen in this research. Miles and Huberman's criteria that have been chosen for this research are as follows:

1. Relevant to the conceptual framework.
2. Degree of producing rich information.
3. Generalizability.
4. Degree of believability of explanation.
5. Ethics.
6. Feasibility.

3.5.3 Justification of Sampling Case Studies

In the planning of this research methodology, there are many different but important considerations. These are significant in impacting on the case study methodology of this research:

1. The particular phenomenon which has been ably distinguished by the author in this research calls for the necessity to choose the case study as the methodology of research to be used – and that is the unclear distinction between phenomenon and context that is entailed in this research as an investigation of an occurrence or phenomenon in contemporary times. With the presence of questions that demand explanations, controlled experiments are less likely as compared with causality, that focuses on the contemporary rather than the historical.

2. Each of the case studies that has been chosen was believed and assumed to be capable of providing a holistic view of the phenomenon where it justifies a descriptive single case study method to be used.

3. Enough consideration has been made of the question of time and skills. Problems that are, in part, practical in nature that may lie ahead of this methodology were also considered in this research, such as the value imputation and the access to information, among others.

The difficulty of generalizing case information from other situations may arise during the case study. When there are few cases of a critical problem, this could be true when a deviant example could be used in defining the phenomenon. It has also been considered in this research.

A case study is expected to capture the complexity of a single case. For the purpose of this research investigation, four contemporary buildings were chosen. Choosing these buildings as case studies is based on certain objectives that can be summarized as follows:

- Location of these buildings: all the contemporary buildings were chosen in Abu Dhabi and Sharjah because contemporary architecture there is considered one of the most developed urban settlements, not only in the UAE but also in the Gulf region. Modern architecture in those cities is of high quality and they are good examples of contemporary architecture in the UAE.

- The chosen case studies represent the most used heritage elements in contemporary buildings in the UAE.

- Access to data was important. Contemporary buildings data was obtained from the Abu Dhabi and Sharjah municipalities, the Department of Heritage Conversation and Preservation of Sharjah, besides the author's field visits and data from local designers and bureaus.

The case studies are composed of four different contemporary structures, which are illustrative and demonstrate one or two (in combination) different architectural heritage elements. These are significant, leading to the creation of guidelines for contemporary architecture that are able to integrate heritage elements in contemporary buildings. These case studies are as follows:

- Case 1: Central Market (Abu Dhabi)

- Case 2: Al Bahr Towers (Abu Dhabi)
- Case 3: Central Souq (Sharjah)
- Case 4: Masdar Institute (Abu Dhabi)

Following the Miles and Huberman criteria being applied to the above chosen case studies, the table below was created to justify and examine those selections (Table 3.3):

Table 3.3: Justification: the quality of the four chosen case studies

Criteria as suggested by Miles and Huberman (1994)	**Case 1** **Central Market** **Abu Dhabi**	**Case 2** **Al Bahr Towers** **Abu Dhabi**	**Case 3** **Central Souq** **Sharjah**	**Case 4** **Masdar Institute, Abu Dhabi**
Relevant to conceptual framework.	Yes: it is relevant to the divisions stated in the initial and final conceptual frameworks.			
Degree of producing rich information	Yes: this particular case study will be able to generate rich information on integrating heritage elements to comply over both functionality and design.	Yes: it will give information on how to integrate sustainable architecture, through the control of light and temperature towards modern architecture.	Yes: could produce rich information due to its heritage value.	Yes: could produce substantial information for the present study; however, with regard to the extent of how rich is still subject to consideration.
Generalizability	There is no certainty over generalizability of the concept towards its application in other structures in general.	Although this has potential, it probably will be low.	The level of expectation may not be satisfied.	This has a fair chance to be substantial case study
Degree to generate a believable explanation	Although this is not considered as criteria, there is a high probability.	Yes: this case could generate a good explanation of the issue of integration between the traditional and contemporary architectural heritage elements.	Yes: expectations are high due to its integrated heritage and cultural aspects.	May not generate an explanation; however, could still be substantive.
Ethics	This was considered; the case study does not require informed consent.	Ethics were considered, as there is substantial archival material available to the public, but not a significant consideration.	Highly considered due to the lack of information provided to the public.	Considered, but not significant in its impact towards the outcome.
Feasibility	They will have noticeable impact on the outcome of the research and the findings of the examined theories.			

3.6 Method of Data Collection

In planning the selected comparative analysis of the chosen buildings, it is essential to identify the appropriate methods to collect the required data for this investigation. The more ways used to confirm the findings, the more certain those findings are. For this research, a multi-method was employed for data collection, including: documents and archival research, field visits, and direct observation of the chosen buildings.

3.6.1 Documents and Archival Research

The non-reactive nature of collecting documentary and archival data represents a distinctive feature of this method. At this point, a possible reactive effect may take place. Using data from archival records and documents in this study helps with:

- Establishing a clear and concrete background about the buildings under investigation.
- Helping in setting a group of evaluation criteria (criteria of the CIPP) to evaluate the selected buildings.
- Define and describe the heritage elements design and efficiency of the chosen buildings.

Types of data required from archival records and documents vary according to the purpose of collecting these data. A number of types of data from archival records and documents were identified as required. They are as follows:

- Information about the buildings, such as location, plot size, building area, functional requirements, and internal spaces.
- Architectural drawings of the building such as plans, sections, elevations and architectural details.
- Photos and images.

The archival records and documents have been obtained from different resources. The main resources can be listed as follows:

- Abu Dhabi municipality.
- Sharjah municipality.

- Department of Heritage Conservation and Preservation of Sharjah.
- Designers and Architectural Bureaus.
- Field visits.

3.6.2 Direct Observation

Observation is an activity of a sapient or sentient living being, which senses and assimilates the knowledge of a phenomenon in its framework of previous knowledge and ideas. Observation is more than the simple act of observing. To perform an observation, a being must observe and seek to add to its knowledge.

Observation is a fundamental way of finding out about the world around us. Human beings are very well equipped to pick up detailed information about our environment through our senses. However, as a method of data collection for research purposes, observation is more than just looking or listening.

Case studies are largely associated with qualitative researches as they depend on analysis and interpretation of texts. “To study a single case intensively need not limit an investigator to qualitative techniques” (Gerring, 2007). Particularly for this research, the researcher will depend on qualitative data to analyze and interpret the answers: “The broad strategy in case study research is to start by collecting data with as open minded as possible. A particular difficulty here is that we will all carry a lot of conceptual baggage with us.” (Gillham, 2010).

The field visit will provide the researcher with the sense of reality on the ground and to observe and ensure the reliability of the obtained answers.

Observations and reflections can play a vital role in supporting the researcher to understand people’s lives and behaviours, among other issues.

This shows that by observation the researcher can also notice new ideas for research benefits.

3.6.3 Participatory Meetings

Meetings are a part of the participatory approach to research. This method has been used to involve different parties in a meeting to discuss specific issues and to share perceptions and ideas, which help people to take the right actions, specifically with the issues that are related to communities. The primary goal is to create productive discussions to develop positive solutions. The researcher should select the participant depending on the desired outcomes from the meeting to ensure that all efforts will be for the benefit of the research (Freeman, 2010).

Table 3.4: Focus group meetings

	Date	Duration	Number of participants	Educational background	Years of experience	Scope of discussion
Meeting 1	10th March 2018	90 minutes	3	Educational Consultant	8 years	• Initial research structure • The research problem • Appropriate methodologies
				Architect	12 years	
				Consultant Engineer	16 years	
Meeting 2	21st April 2018	60 minutes	3	Architect	12 years	• Case study 1 • Case study 2
				Architect	5 years	
				Consultant Engineer	16 years	
Meeting 3	19th May 2018	45 minutes	3	Architect	12 years	• Case study 3
				Architect	5 years	
				Consultant Engineer	16 years	
Meeting 4	28th July 2018	45 minutes	3	Architect	12 years	• Case study 4
				Architect	5 years	
				Consultant Engineer	16 years	
Meeting 5	20th October 2018	90 minutes	4	Educational Consultant	8 years	• Final research framework • The set of recommendations • The relativity of the findings in regard to the research objectives
				Architect	12 years	
				Architect	5 years	

				Consultant Engineer	16 years	

In order to conduct valid information that fulfills the questions of the research with appropriate findings from different perspectives, five focus group meetings were held to share opinions and discuss relevant ideas that enhance the research. Participants from various fields brainstormed to provide valuable comments for the suggested case studies (

Table 3.4).

3.7 Method of Data Analysis (CIPP)

In order to fulfill the empirical objectives of this research and to evaluate the case study buildings chosen, a systematic approach was used (CIPP, which stands for Context, Input, Process and Final Product (the building)), for generating valuable information to produce a comparative analysis that will lead straightforwardly to the final findings of this research.

The below CIPP sample shows how the case studies will be evaluated in the following chapter (Table 3.5):

Table 3.5: CIPP sample for case studies

CONTEXT	The foreign architects' concept behind the selected case study.
INPUT	The local involvement to the concept using the heritage elements.
PROCESS	Usage of the heritage element in order to function in the contemporary building.
PRODUCT	Whether the element in the building is functioning or is a veneer.

3.8 Initial Conceptual Framework

To organize the concepts which the researcher had in consideration while starting this research, an initial conceptual framework had to be assigned in order to clarify the degree of understanding for the chosen case study to develop it to a final conceptual framework in the following chapters, after examining the buildings in depth and enhancing the knowledge of the

implementation of heritage elements in contemporary buildings of the United Arab Emirates (Table 3.6,
Table 3.7,
Table 3.8 & Table 3.9):

Table 3.6: Abu Dhabi central market heritage elements layout

INVESTIGATION ASPECTS					
		Efficiency	**F/NF**	**Implementation**	**T/D**
ABU DHABI CENTRAL MARKET HERITAGE ELEMENTS	**MASHRABIYA**	VISUAL	F	VISUAL	D
		THERMAL	NF	THERMAL	D
		AESTHETIC	F	AESTHETIC	D
	WIND TOWER	VISUAL	-	VISUAL	-
		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	COURTYARD	VISUAL	F	VISUAL	T
		THERMAL	F	THERMAL	T
		AESTHETIC	F	AESTHETIC	T
	BROKEN ENTRANCE	VISUAL (PRIVACY)	-	VISUAL (PRIVACY)	-

Table 3.7: Al Bahr towers heritage elements layout

INVESTIGATION ASPECTS					
		Efficiency	**F/NF**	**Implementation**	**T/D**
AL BAHR TOWERS HERITAGE ELEMENTS	**MASHRABIYA**	VISUAL	F	VISUAL	D
		THERMAL	F	THERMAL	D
		AESTHETIC	-	AESTHETIC	-
	WIND TOWER	VISUAL	-	VISUAL	-
		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	COURTYARD	VISUAL	-	VISUAL	-
		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	BROKEN ENTRANCE	VISUAL (PRIVACY)	-	VISUAL (PRIVACY)	-

Table 3.8: Sharjah Central Souq heritage elements layout

INVESTIGATION ASPECTS					
		Efficiency	**F/NF**	**Implementation**	**T/D**
SHARJAH CENTRAL SOUQ HERITAGE ELEMENTS	**MASHRABIYA**	VISUAL	F	VISUAL	T
		THERMAL	F	THERMAL	T
		AESTHETIC	F	AESTHETIC	T
	WIND TOWER	VISUAL	F	VISUAL	T
		THERMAL	F	THERMAL	T
		AESTHETIC	F	AESTHETIC	T
	COURTYARD	VISUAL	-	VISUAL	-
		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	BROKEN ENTRANCE	VISUAL (PRIVACY)	-	VISUAL (PRIVACY)	-

Table 3.9: Masdar Institute heritage elements layout

INVESTIGATION ASPECTS					
		Efficiency	**F/NF**	**Implementation**	**T/D**
MASDAR INSTITUTE HERITAGE ELEMENTS	**MASHRABIYA**	VISUAL	F	VISUAL	D
		THERMAL	F	THERMAL	D
		AESTHETIC	F	AESTHETIC	D
	WIND TOWER	VISUAL	-	VISUAL	-
		THERMAL	F	THERMAL	T
		AESTHETIC	F	AESTHETIC	T
	COURTYARD	VISUAL	-	VISUAL	-
		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	BROKEN ENTRANCE	VISUAL (PRIVACY)	-	VISUAL (PRIVACY)	-

3.9 Research Ethics

According to Gilbert (2001), "Ethics is a matter of principled sensitivity to the rights of others. Being ethical limits the choices that pursuit the truth. Ethics say that while truth is good, respect for human dignity is better, even if, in the extreme case, the respect of human dignity leaves one ignorant of human nature."

Therefore, ethical issues are the core of any research and they are the tools of successful research. They are also a supporting element, because they will provide the participants with confidence to release their ideas and attitudes.

In the following section, some ethical principles are stated that the researcher should consider in this research:

- Firstly, "informed consent" and getting permissions to interview the employees from bureaus, to get the needed data for the research, besides whether they are willing to help or not.

- Secondly, “expected duration” and determined time is important as it may be an inconvenience for participants. For example, it may not be appropriate to interview the employees during their duty for one hour.

- Thirdly, “Field visiting permissions”; the case study buildings chosen were all public buildings that require permissions for photographs and data collection for maintaining public security, therefore the researcher should consider facing some difficulties to obtain the needed information from the concerned fields.

What is more, the researcher should consider the ethical issues in different areas and countries, because there could be some different issues and dimensions in different cultures and communities. Therefore, this research will consider the ethical issues in the UAE.

3.10 Validity and Reliability

3.10.1 Reliability

The term reliability is a concept that is being employed for the testing or assessing of qualitative research, which can be applied to other research.

The test of any qualitative study is its quality, seeing testing as a way of eliciting information. Most especially in this research was a particular situation in contemporary architecture in the UAE; a good qualitative study would be able to explain such a situation that would normally be either confusing or enigmatic (Eisner, 1991). This pertains to the concept of good quality research when the evaluation of quality in a qualitative study is with the “purpose of explaining” while the concept of quality in a qualitative study has the purpose of understanding generation (Stenbacka, 2001).

One of the reasons that the concept of reliability is irrelevant in qualitative research is the difference in purpose of evaluating the quality of studies in both qualitative and quantitative research. In qualitative research, the concept of reliability is often misleading. The consequence

is rather that the study is not good when reliability is being discussed in a qualitative study. Any qualitative researcher should be concerned with validity and reliability of the research (Patton, 2001). The quality of a study in each paradigm should be judged according to the term of its own paradigm in answer to that question (Healy & Perry, 2000).

One measure that might express the qualitative research dependability is the inquiry audit as further emphasized by Lincoln and Guba (1985).

Seale (1991) approves of the concept of reliability or consistency as the idea of dependability in qualitative research. When the steps of research are verified through examination, the consistency of data will be achieved with such items as raw data, data reduction products, and process notes (Campbell, 1996). The examination of the issue of trustworthiness is crucial to ensure that data is reliable in qualitative research. While establishing good quality studies through reliability and validity in qualitative research, Seale (1999) argues that the research's trustworthiness lies at the heart of issues conventionally discussed as validity and reliability. Strauss and Corbin (1990) suggested that when judging qualitative work, the usual laws of good science require redefinition so that it becomes suitable for the realities of qualitative research. It is argued, however, that the issue of reliability is an irrelevant matter in the quality of qualitative research judgment (Stenbacka, 2001).

In order for the spectrum of conceptualization to become wider and result in the revelation of the congruence of validity and reliability of qualitative research, it is argued that since there can be no validity without reliability, a demonstration of the former is sufficient to establish the latter (Lincoln & Guba, 1985). Through the skill and ability of the researcher in any qualitative research, as Patton (2001) argued, reliability is just a consequence of the validity of the study.

3.10.2 Validity

In qualitative study parlance, the concept of validity can be described by a wide range of terms. This term is not a universal, single and fixed concept but it is a "dependent construct that is in the process, grounded for the research methodologies and project intentions". While it is argued that

the term validity is not applicable in qualitative research, as has been argued by some qualitative researchers, at the same time they had realized that there is a need for a qualifying check to measure their research. For instance, it is suggested that the perception of the researcher of the validity will affect the validity itself, as well as the choice of paradigm assumption. Many researchers have developed their own concept as a result of validity and have often generated or adopted appropriately considered terms such as rigour, quality and trustworthiness (Lincol & Guba, 1985; Davis & Dodd, 2002). The concerns about validity and reliability in quantitative tradition initiated the discussion of quality in qualitative research, which constitutes substituting new terms for words such as 'reliability' and 'validity' to symbolize observations (Seale, 1999).

The issue of validity in qualitative research has not been ignored by Stenbacka (2001) as she had an issue of reliability in qualitative research. Instead, she argues that the concept of validity should be redefined for qualitative researches. Stenbacka (2001) describes the notion of reliability as one of the quality concepts in qualitative research which is "to be solved in order to claim a study as part of proper research".

Davis and Dood (2002) discovered the term rigour in the process of investigating the meaning of rigour in research when it appears in reference to discussions about reliability and validity. Sustaining the trustworthiness of each research report, Lincoln and Guba (1985) depended on the extent of the research validity and reliability. The idea of discovering truth through measures of reliability and validity is replaced by the idea of trustworthiness, which is "defensible" (Johnson, 1997) and establishing confidence in the findings (Lincoln & Guba, 1985). If the issues of reliability and validity, reliability and trustworthiness mean distinguishing research as being good from bad, then testing and increasing the reliability, validity and trustworthiness, quality and rigour will be important to research in any paradigm.

3.11 Summary

Chapter Three: Research Methodology – This chapter discusses the methodology which this research has adhered to. In this research, the 'case study' method has been used and this chapter justifies it accordingly.

This chapter introduced a framework of analysis that is be used in this present research. It will lead towards thoroughly tested findings of the ‘case study’ method of contemporary architecture, which relies on different architectural structures by way of the ‘case study’ method.

This chapter focuses mainly on the planning of this methodology by first setting out objectives for the ‘case study’ analysis, which will give a rationale of why the ‘case study’ had been chosen as a point of methodology in this research and consequently will be discussed thoroughly. Criteria for the investigation of the selected case studies shall be determined and identified, as well as the method that will be used in the analysis of the collected data.

Each of the case studies chosen was believed and assumed to be capable of providing a holistic view of the phenomenon where it justifies a descriptive case study method to be used.

Chapter 4
CASE STUDIES DISCUSSIONS

4.1 Introduction

Every country's architecture shows development and past traditions over generations. The UAE's modernization achievements are impressive, as indicated by many social and economic changes in the last few decades (Shihab, 2007). Unfortunately, due to this fast-paced modernization, the UAE's heritage and identity has been declining.

This research has three fundamental objectives: to identify architectural heritage elements, their status at the present time and how these elements can be integrated into future architectural design.

In the previous chapters, this research has been very keen to establish and identify these architectural heritage elements and the different needs of its Emirati inhabitants; social, cultural and environmental. Then it was necessary to design a methodology to specifically suit this investigation and finally to justify how different criteria could be used to identify, evaluate and assess architectural heritage elements in the contemporary buildings of the UAE.

This chapter seeks to expand on the following objectives:

Evaluation, analysis and results of the research methodology and design.
To design a guideline as a form of strategy of how the UAE's architectural heritage elements could be integrated into the design of future architectural structures, notwithstanding the requirements of modern buildings.

As mentioned earlier in the previous chapter, four case studies were nominated to create a fruitful discussion of the four architectural heritage elements that have made it through to this era in the UAE.

Data will be generated as a result of the four heritage elements analysis in each case study (Table 4.1). Data analysis will be conducted to find the effectiveness of the incorporation of using the

heritage elements within the contemporary architecture and therefore evaluating the functionality of these elements in order to reach sufficient findings that fulfill the main objectives of this research.

Table 4.1: The heritage elements in each case study

Elements	**Case Study**			
	Central market Abu Dhabi	Al Bahr towers	Central Souq Sharjah	Masdar institute
Mashrabiya	✓	✓	✓	✓
Wind tower			✓	✓
Courtyard	✓			✓
Broken entrance	✓		✓	

CASE STUDY 1

"ABU DHABI CENTRAL MARKET"
Client: Aldar Properties (2006-2011)

Figure 4.1: Abu Dhabi Central Market
Source: Abudhabi Municipality, 2018

4.2 Introduction

The mall at the world trade center, Abu Dhabi, is a contemporary revival of a historic district within the heart of the capital – 'the old Central Market, which was the business and trading hub' is now a fully integrated, mixed-use development with a souq (traditional market), offices and residences. It is a unique retail destination for shoppers, which has a traditional souq that is a contemporary interpretation of the traditional Arabian market but also incorporating a modern high-tech commercial district – "the mall" – plus three levels of roof gardens and public squares.

4.2.1 History

The old Abu Dhabi Souq was an iconic trading and meeting place for merchants (Figure 4.2), from neighbouring countries and locals.

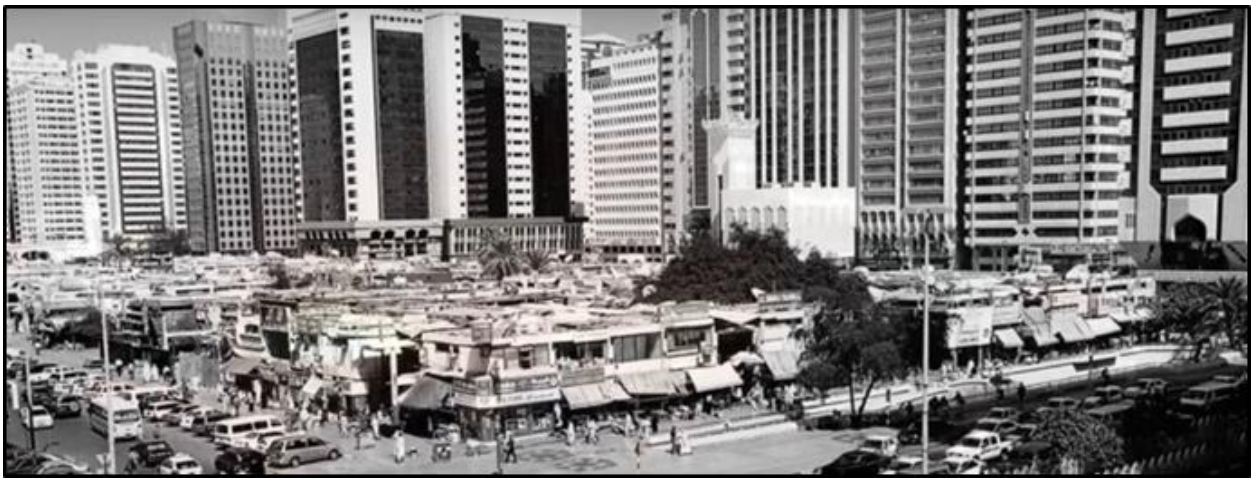

Figure 4.2: The old Abu Dhabi souq
Source: The National sounds and vision 2013

It was one of the first projects commissioned by Sheikh Zayed (UAE's first president) for the 'Abu Dhabi Master Plan' and was completed in the 1970s, though it was destroyed by fire in 2003 (Figure 4.3).

Figure 4.3: The old Abu Dhabi souq fire
Source: The National sounds and vision 2013

In 2007, a reconstruction of the Abu Dhabi Central Market was being decided then by the government. An indoor souq was considered over the more traditional authentic Abu Dhabi outdoor souqs, as it would be more convenient for the end users considering the UAE's harsh weather conditions.

The newly reconstructed central souq was then called 'The Mall' at the world trade center Abu Dhabi. It has been one of the new additions among the contemporary buildings of Abu Dhabi. In particular, the souq has become a central part of the community for locals and visitors.

4.2.2 Case Study Details

Architects: Foster + Partners
Location: Abu Dhabi - United Arab Emirates
Project Team: Norman Foster, David Nelson, Gerard Evenden, Stuart Latham, Muir Livingstone, John Blythe, Edson Yabiku, David Crosswaite, Giulia Galiberti, Sandra Glass, Ashley Lane, Giulia Leoni, Emily Phang, Bram van der Wal, Ho-Ling Cheung, Luca Latini, Franquibel Lima, Chris Nunn, Riccardo Russo, Jillian Salter, Ronald Schuurmans, Sunphol Sorakul, Daniel Weiss, Laura Podda, Yong Bin Kim, Yvonne Jendreiek
Area: 689,416.0 sq.m.

Project Year: 2014

Project Manager: WS Atkins

Structural Engineer: Halvorson and Partners

MEP Engineer: BDSP Partnership

Collaborating Architect: Planar

Cost Consultant: EC Harris International

Façade Consultant: Arup

Client: ALDAR Properties PJSC

Site Area: 3.94 hectares

4.2.3 Site Location and Accessibility

The souq was built exactly in the same location as the first souq of the city, which was an open-air setting. The souq has a special location (Figure 4.4) that has access from three main roads, northwest by Khalifa Bin Zayed ST, southwest by Rashid Bin Saeed ST and Hamdan Bin Mohammed St from southeast, and it is equipped with over a 5000-car-capacity parking space.

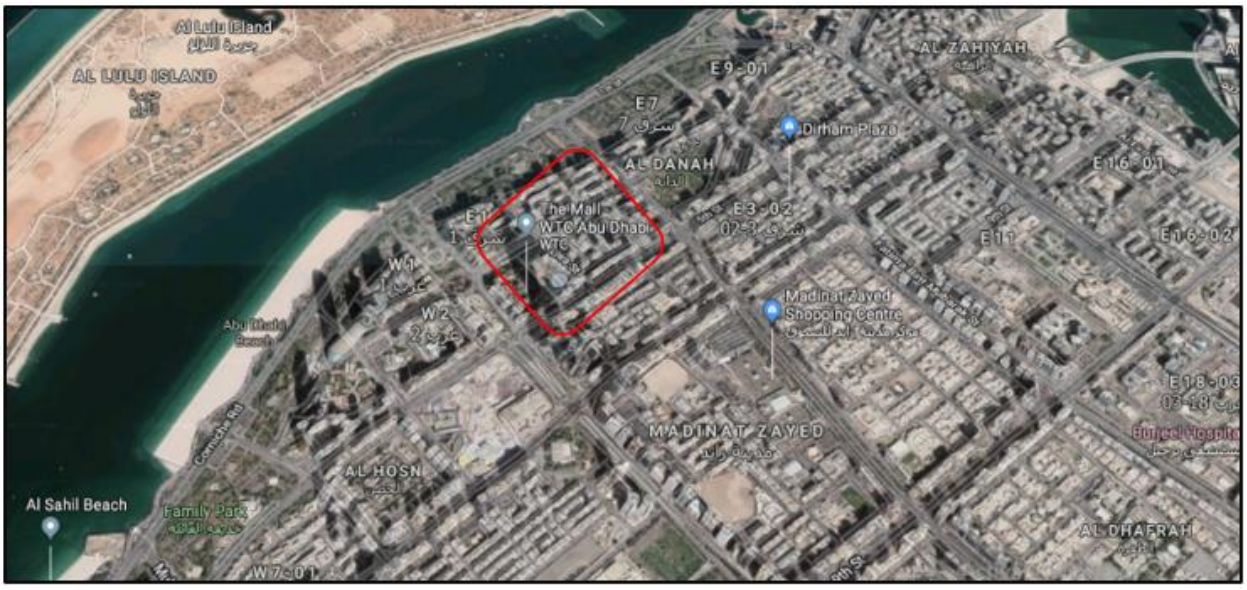

Figure 4.4: The Abu Dhabi central market location
Source: Google Earth 2018

4.2.3.1 The Souq

This location enriches the souq value as it makes it more reachable to consumers, with six entrances on the ground floor towards the souq building from the surrounding main roads in addition to an underground car access that is connected to the souq by elevators (Figure 4.5).

Figure 4.5: The entrances for the souq building
Source: Abu Dhabi Municipality

4.2.3.2 The Mall

On the other hand, the mall has two main entrances directed towards the souq facing the pedestrian walking paths, in addition to six underground car parking ramps (Figure 4.6) that gives more accessibility to the building and makes it more convenient to the end users – "shoppers".

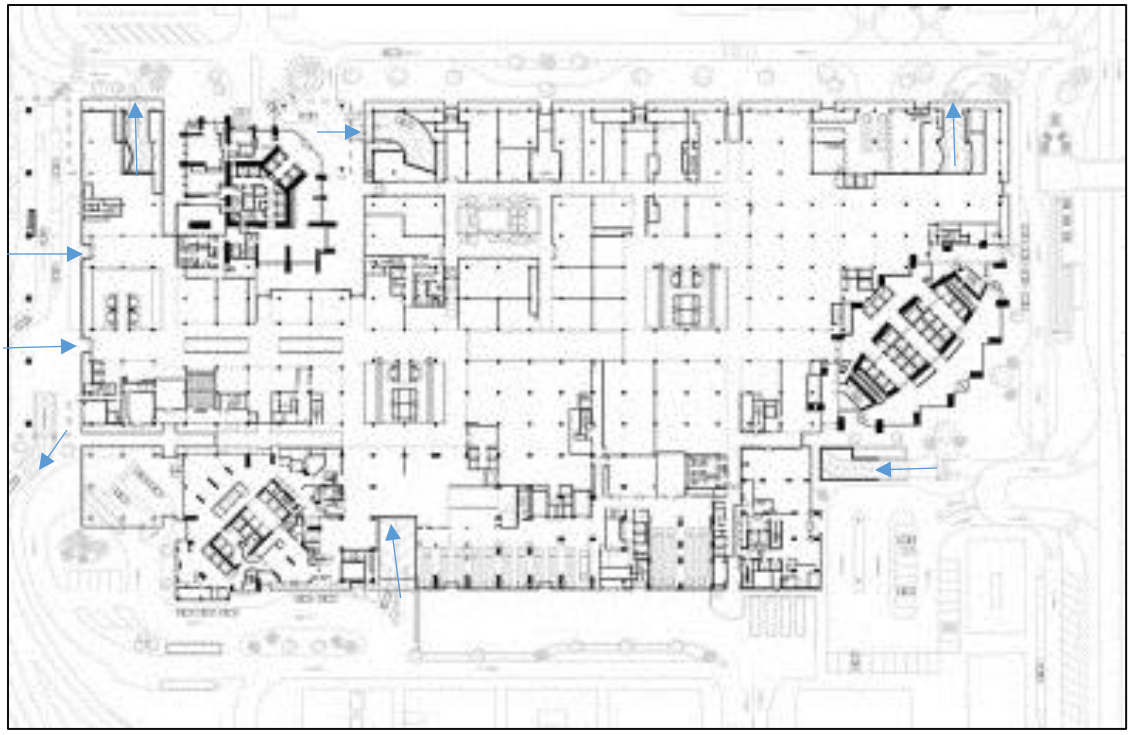

Figure 4.6: The entrances for the mall building
Source: Abu Dhabi Municipality

4.2.4 The Design

Aldar Properties commissioned Foster + Partners to design the new Abu Dhabi Central Market in 2006.

The philosophy of this design was straightforward; they wanted to renovate the historic Central Market as a modern building, at the same time as borrowing and including the past.
They designed it encompassing lattices, which resemble the mashrabiya. The interior has spaces that resemble traditional courtyards and narrow alleyways.

The project comprises a combination of lower-rise, ecologically sensitive levels of retail, roof gardens – forming a new public park – and three towers, with numerous underground parking areas which are pushed to the corners of the site to maximize the ground plan.

The design is a distinctive modern interpretation, through offering an alternative to the usual globalized one-size-fits-all shopping. Different experiences are brought together like a traditional

souq in an interior of dappled sunlight, fountains and bright colours with an alternating rhythm of courtyards, squares and alleyways.

Foster + Partners took into consideration that the climate in Abu Dhabi is agreeable from October to March when it is pleasant to sit or stroll outside. By creating sequences of public routes and squares, the barriers between the exterior and interior have been eliminated.

Like a modern version of the souq, the new Central Market will be a city in microcosm. It will unite high-end retail and luxury goods shops, together with food markets and craft-based trades specific to the region. Avoiding the generic feel of the universal shopping mall, the scheme will fuse the local vernacular with global aspirations.

While the towers relate to distance and skyline, the souq and the lower levels are scaled to the pedestrian. An intimate sequence of streets, alleys, courtyards, balconies and colonnades dissolve barriers between inside and outside, with flexible sliding roofs and walls to enable control of internal environments, and to maximize potential for natural ventilation. Like a patchwork quilt of gridded modules of varying height, the scheme is a highly articulated composition that bridges and unifies two city blocks.

The architecture of the Central Market was planned to mimic a traditional Emirati souq with contemporary design. The concrete façade gives a desert experience where sand has been ingrained.

4.2.5 Building Mechanism

Foster + Partners, within their design made it possible to close the roof from March to September (when temperatures can reach 50°c) to control the internal environment. The perforations of the panels and roof create a pattern of Islamic design and wrap the façade in a texture.

The site is generously landscaped, in keeping with other sites in Abu Dhabi; the roofs of the podium buildings form a series of terraced gardens. A cluster of tall buildings rise above this, dense and close-grained, which vary in terms of mass and height depending on whether they contain offices, apartments or a combination of hotel and serviced apartments. Visually they

form a family, with smooth, reflective facades designed to need little maintenance in this dusty desert environment. Layers of internal shading on the towers control glare and solar gain.

4.2.5.1 Adaptive Building Initiative's Permea System

When energy enters and exists in a particular architectural structure in the form of light and heat in a manner that is uncontrolled, the result is an unwelcoming fluctuation within the internal environment: the temperature in the space may become too hot or too cold, too bright or too dark. However, if the outer envelope of the building can prevent energies that are unwanted and transfer them from occurring in the first place, energy consumption would drop and mechanical workarounds would be necessary dramatically.

The result is that kinetic design works off of an operable grid. In its covered configuration, the shading roof resembles a traditional Islamic roof. When retracted, the roof becomes a slim lattice.

Adaptive Buildings Permea is a self-contained unitized system that is capable of controlling permeability, varying smoothly between a largely open and completely covered state. It can be adjusted and customized in order to create a seal to protect against dust and debris over large areas. It is capable of being installed in a non-vertical orientation and customized for non-rectangular shapes. It can move parallel to the surface of the building, allowing its layers to be hidden when retracted completely. Unitized integration with the building and an unparalleled level of control over patterning are its additional benefits. It can be engineered for special situations to function as a protective blast shield in a building.

The Central Market has been supportive towards turning the modern shopping mall, as well as other towers that are surrounding it, into a green and sustainable project. Roofs and sliding walls help to cut energy costs by maximizing ventilation and using natural light. The materials used in construction and lighting and cooling systems will help to reduce the carbon footprint.

4.2.5.2 Heritage Elements of the Abu Dhabi Central Market

The Central Market provides an internal vista of green parks, fountains and pools overlooking the Abu Dhabi Corniche. The waters front a courtyard concept with alleyway features in the interior of the building, with wooden lattices covering most of the internal walls and ceilings of the souq and the mall, in addition to mashrabiyas featuring on the exterior façades.

4.2.5.3 The Mashrabiya

The mashrabiya within the building is placed on several building elements; some are functional rather than being aesthetic views, although there are many on the external façade which are positioned for the artistic heritage design of the building.

- Some internal ceilings of the building have coloured glass-aluminum lattices that resemble the mashrabiya. These lattices provide natural lighting which enhances the indoor environment (Figure 4.7).

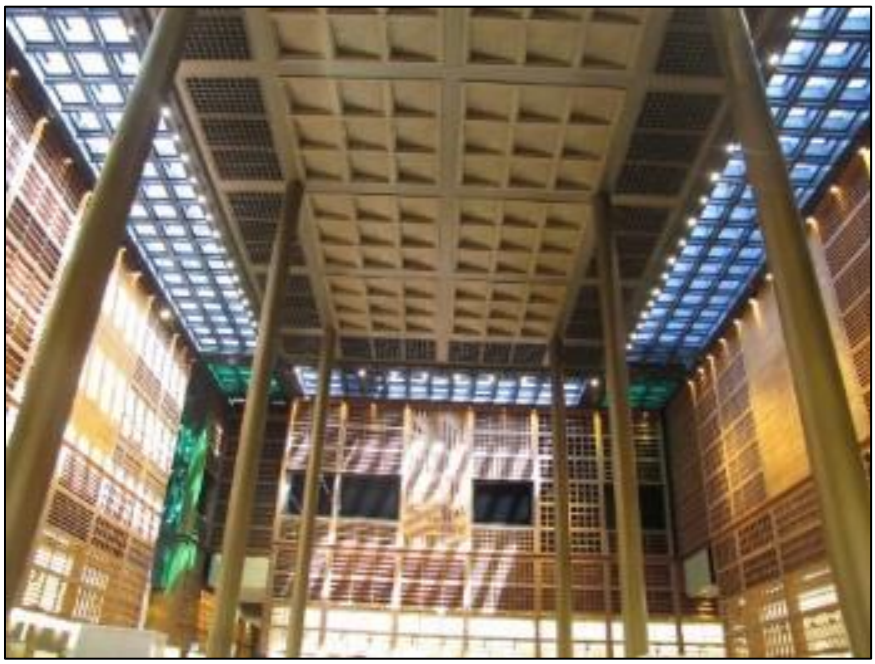

Figure 4.7: Internal ceiling with mashrabiya windows

In addition to wooden lattices that cover most of the other non-glass ceilings which were positioned as a fall-ceiling to shield the building services pipes and cables from the users' sight (Figure 4.8 and Figure 4.9).

Figure 4.8: Mashrabiya fall-ceiling hiding building services

Figure 4.9: Mashrabiya fall-ceiling supporting signs and light fixtures

For aesthetic purposes, wooden lattices are used to cover the walls of the alleys in the buildings and some of the shops' interiors to enrich the overall atmosphere of the Central Market (Figure 4.10 and Figure 4.11).

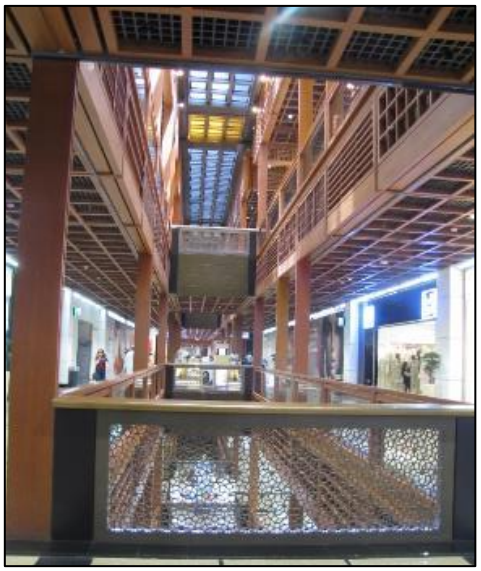

Figure 4.10: Mashrabiyas covering the sides of the alleys

Figure 4.11: Mashrabiyas covering the walkways' boundaries

The external façade of the building is also partially covered with vertical coloured glass-aluminum lattices (Figure 4.12), enhancing the initial aim of the design and highlighting the heritage signature of the building.

Figure 4.12: Mashrabiyas covering the external walls

Figure 4.13: Wooden lattices covering the walkways' boundaries

The other parts of the external façade are covered with wooden lattices that act as a secondary façade (Figure 4.13) to the building above glass-aluminum to avoid unpleasant heat gains and direct sunlight, in addition to a heritage appearance for viewers.

4.2.5.4 The Courtyards

In this case study, two courtyards existed within the building, both fulfilling the courtyard's main purpose within the design of any structure, performing as a social hub and providing natural light for the internal zones.

The courtyard within the souq (Figure 4.14), is located in the heart of the building, connecting all the alleys to the focal zone that is the courtyard.

It is the central point of the building that has all the main shops, restaurants and sitting areas which automatically led to creating a social square.

The courtyard offers sufficient natural light during winters, while it requires additional artificial light during summers to provide the lighting needed.

Figure 4.14: Courtyard of the souq building

The Mall courtyard (Figure 4.15) is more of a social hub that is surrounded by restaurants and sitting spaces, fulfilling almost the same purposes as the souq courtyard but without any shops.

Figure 4.15: The courtyard of the Mall building

4.2.5.5 Broken Entrance

The broken entrance aim has developed to be more convenient in the malls of the country, being used in washrooms, prayer areas and every private zone that shouldn't be seen by people passing by the walkways.

The broken entrance is used as a privacy element within the building at the entrances of the washrooms (Figure 4.16) and ablution areas, creating long broken alleys to evade unpleasant sights (Figure 4.17).

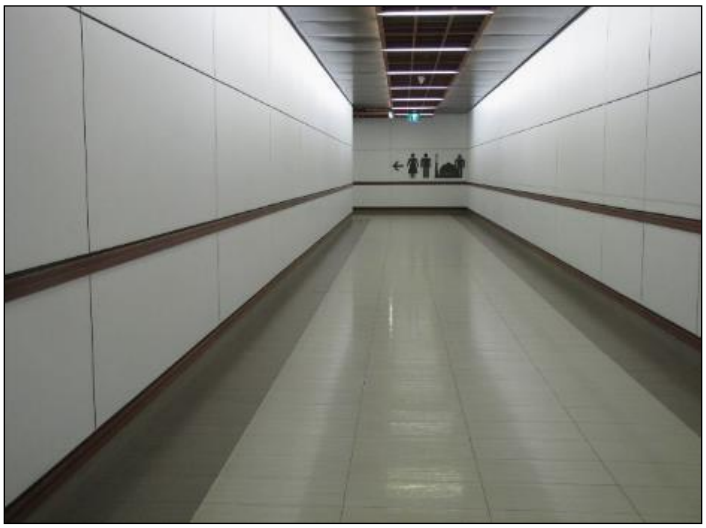

Figure 4.16: Broken entrance before the facilities areas

Figure 4.17: The walkway after the broken entrance

4.2.6 CIPP for Case Study 1

In order to examine the above-mentioned heritage elements of the Abu Dhabi Central Market, the CIPP will be applied for evaluating the building and the efficiency of all the used elements.

Table 4.2: CIPP for Abu Dhabi Central Market

CONTEXT	The building's concept was based on the traditional central souq purpose and impact on society. A new central market idea was established to replace the old burnt market. The new central market building had to have a heritage appearance involving heritage elements within the external and internal design.
INPUT	The government considered protecting the heritage image of the souq so it involved Emirati heritage elements in the design concept of the foreign architects.
PROCESS	Implementing the local heritage elements in order to accelerate the modern technology purposes used within the building. Developing the heritage elements in order to fulfill the energy and environmental aims proposed. Using the heritage elements in the traditional way for aesthetic purposes.
PRODUCT	A well-developed usage of the traditional mashrabiya in order to enhance the design of the building and its sustainability. Sufficient lighting and social impact of the courtyards in the building that have sufficiently achieved the concept counselled.

4.2.7 Discussion of Case Study Analysis

Based on the above-mentioned analysis of the heritage elements used within the building of Abu Dhabi Central Market, hereby a detailed discussion will be set, stating the observations of the elements' sufficiency.

In this case study the **mashrabiya** is going back to its very essential definition that is dominantly governed by its function rather than the aesthetic view, although there are a few zones of the building that have used it as a design heritage element, to some extent neglecting its function.

Within the building the **mashrabiya** had its traditional uses, which are as follows:

The visual effect of the mashrabiya was used in several locations within the internal and external areas. It was placed on the ceilings and windows in order to reduce glare and prevent unpleasant direct sunlight, which is not only disturbing for the users but can also be harmful and tiring for the eyes, making workers uncomfortable and less productive after several hours in the building.

On the beneficial aspect of the interior design of the building, the glass-aluminum coloured mashrabiyas allow limited coloured light to enter the structure, which works to enrich the internal spaces' scheme and colours and enhances the overall atmosphere of the place.

On the other hand, following the designers' concept of creating a sustainable, energy-efficient building, the mashrabiya allows diffused natural light to the inner extents of the building, which acts to reduce the need to use artificial lights, yet controls the amount of lighting to eliminate undesirable heat gains.

Improving the luxury vision and perception drives along Abu Dhabi's wealthy global image. In addition to maintaining the Emirati traditional architectural view of the building, the mashrabiya was used **aesthetically** in aligned wooden and coloured glass-aluminum lattices, covering the external walls of the building as well as wooden lattices positioned on the internal walls and ceilings.

From a **thermal** point of view, for up to six months of the year the climate in Abu Dhabi is pleasant and comfortable enough to minimize the need of mechanical ventilation. That has inspired the creation of mashrabiyas on the ceiling that open at night as well as during the day, providing a constant pleasing flow of air to cool the interior environment.

On the other hand, the **mashrabiya** had been used within the building for developed modern purposes which will be mentioned below:

As acknowledged, the traditional mashrabiyas were only used for external facades; in this case study it was placed within the interior and exterior walls and ceilings for the same aesthetic uses.

In developing usage of the mashrabiya, the building services such as smoke detectors, sprinklers, chiller ducts and electric wire tracks were covered by wooden lattices to perform as a fall-ceiling supporting the exit signs and lighting tracks.

The mashrabiyas were also placed on the ceiling, creating a roof that covers the courtyard which could be opened during pleasant weather, creating a developed concept rather than the traditional courtyard that has no roof and constantly opened to different climate situations.

The **courtyards** in this case study preserved their traditional usage as being a social hub that creates a user-friendly environment for social gatherings, which justifies the placement of them in the lively occupied centre of the buildings.

The **courtyards** were successfully developed to have ceilings that allow limited natural light in the building, which requires some artificial lighting sources to sufficiently fulfill the lighting requirements for the courtyard zones. Placing limited numbers of mashrabiyas to cover the courtyards minimizes the solar heat gains, therefore using lesser mechanical ventilation within the summer months as well as providing an appropriate cool breeze when opened during the winter months. This mechanism stands for a smart, sustainable, well-designed structure that compromises some artificial lights' energy consumption in order to create energy-friendly zones from a thermal point of view.

Broken entrances in this building were not placed in their traditional locations on the main entrances; nonetheless, they were positioned to meet the privacy needs of a modern building on the walkways towards the private facilities of the buildings which preferably should be hidden from the sight of unconcerned people, such as building management offices, AHU rooms, washrooms¸ prayer rooms and their facilities and eventually security.

Case Study 2

"AL BAHR TOWERS"

Client: Abu Dhabi Investment Council (2009-2012)

Figure 4.18: Al Bahr Towers

4.3 Introduction

The Al Bahr Towers features the world's largest computerized dynamic façade, consisting of two 29-storey, 145m-high towers, one of which houses the new headquarters of Abu Dhabi Investment Council (ADIC). The other serves as the head office of Al Hilal bank. They have become a landmark in embracing heritage in contemporary times, but also a firm demonstration of the UAE's commitment towards sustainability and environmentally-friendly design. The façade is regarded as a modern interpretation of the mashrabiya that achieves both lighting and thermal control in structures within the UAE.

4.3.1 History

In order to generate the form of the towers, Aedas applied the principles of geometric composition derived from traditional Islamic architecture. Geometric composition has been a defining characteristic of Islamic architecture since the 13th century, with the circle and rotation reflecting the concept of unification and unity evident in nature, which is an important concept in Islamic design and in the emerging science of biomimicry.

Following an intense period of analysis, and influenced by both the client's brief and also the orientation of the site, Aedas began to develop the distinctive form of the towers using parametric design techniques to generate a defining geometry. Their starting point was two cylindrical towers (Figure 4.19), a circle producing the most efficient form in terms of wall to floor area whilst also creating the greatest volume with the least surface area.

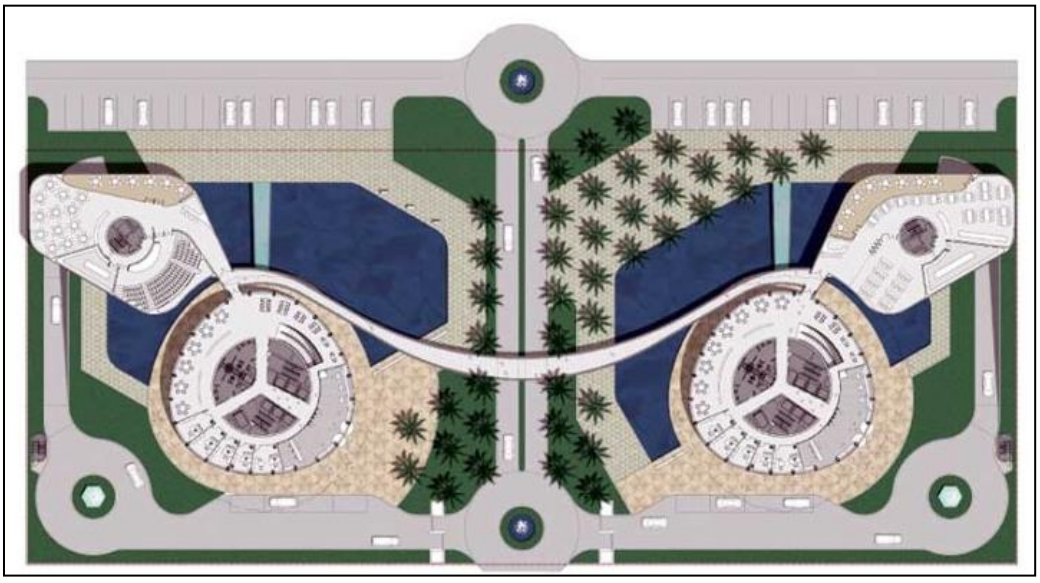

Figure 4.19: The plan of Al Bahr Towers
Source:Abudhabi Municipality, 2018

The radial plan form was articulated to reduce solar exposure on the most heavily exposed elevations. The form of the towers was then sculpted around the core, narrower at the base and at the top, but broader around the intermediate floors (Figure 4.20).

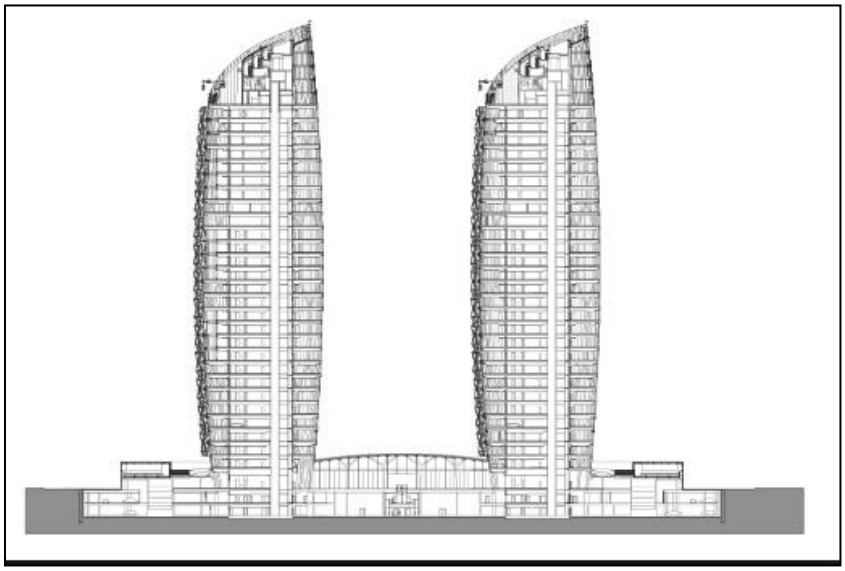

Figure 4.20: Al Bahr Towers elevation
Source:Abudhabi Municipality, 2018

The crown of the tower was cut at an angle to maximize solar gain for roof-mounted photovoltaic panels (Figure 4.21). Sky gardens were introduced in the most heavily exposed southerly elevation to further reduce solar gain while providing an amenity space.

Figure 4.21: Roof photovoltaic panels
Source:Abudhabi Municipality, 2018

Having established an underlying geometry, the team was then able to erode the elevation in order to generate the structural and cladding grids.

4.3.2 Case Study Details

Completion Date: June 2012
Height: 145 m
Stories: 29
Area: 56,000 m^2
Primary Use: Offices
Owner/Developer: Abu Dhabi Investments Council
Design Architect: Aedas Architect, Ltd
Associate Architect: Diar Consult
Structure Engineer/MEP Engineer: Arup
Project Manager: Mace International
Main Contractor: Al-Futtaim Carillion
Other Consultants: Davis Longdon, Townshend Landscape Architects, NSCC, William Hare, Yuanda.

4.3.3 Site Location and Accessibility

Al Bahr Towers are located between Al Saada Street and Al Salam Street at the eastern intersection in the city of Abu Dhabi (Figure 4.22). Between the towers, a 100m-wide curved roof forms a shallow dome over the entrance podium, its front partially glazed and forming an entrance to the buildings.

Arriving visitors and workers enter this fully conditioned space and can proceed directly to either tower, to the main auditorium, or to one of the prayer rooms.
In addition to this main entrance, each tower has a dedicated VIP entrance accessed at mezzanine level from the far side of the podium.

Figure 4.22: Site location and access
Source: Google Earth

4.3.4 The Design

The design concept of Al Bahr towers is a synthesis between sustainability, traditional architecture and performance-based technology. The design has accomplished a high-technology, culturally relevant and aesthetically outstanding building with a unique identity.

The Aedas' innovative competition-winning design is derived from an algorithmic composition, informed by Islamic principles of design that has been supplemented by the application of a dynamic translucent mashrabiya (Figure 4.23).

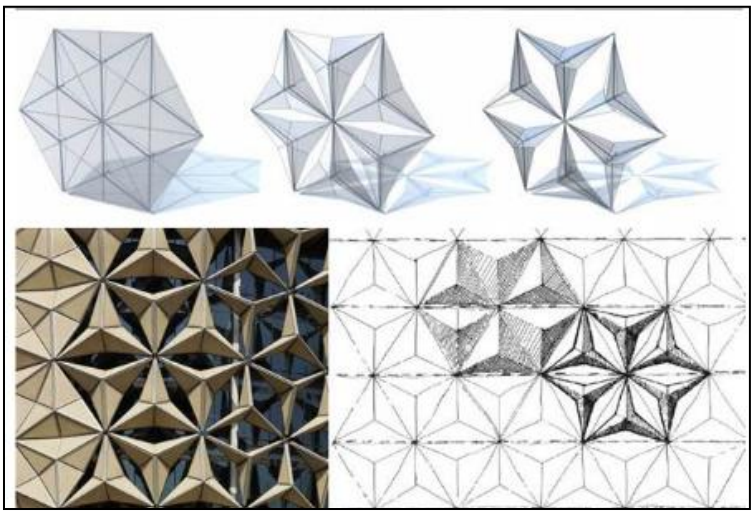

Figure 4.23: Shading system mashrabiya concept
Source: Aedas, 2018

One of the main concepts is the shading system of the mashrabiya, and this has led to the winning of the tender for the construction of the towers by Aedas, which would eventually house the headquarters of Abu Dhabi Investment Council (ADIC).

Powered by a computational design team (Figure 4.24), the work of architects and engineers was to find a parametric description for the geometry of the movable panels on the facade and simulate its operation in response to sun exposure and the consequent change of incidence angles during different days of the year.

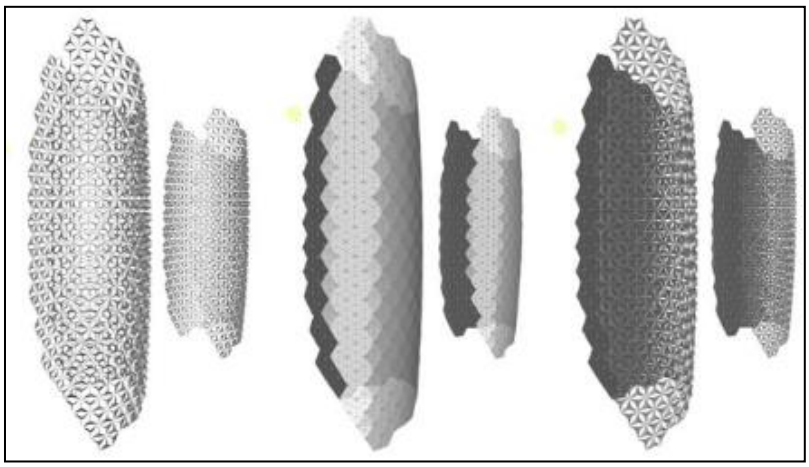

Figure 4.24: Computational design for Al Bahr towers
Source:Abudhabi Municipality, 2018

The architectural façade that results in this conceptual idea aims to create an architectural structure that responds to both requirements of culture and environment, which symbolizes the aspirations of the designer towards the sustainability aims of the inhabitants and the intentions of the Abu Dhabi 2030 Sustainability Plan. The Urban Structure Framework Plan is designed to help Abu Dhabi filter and respond to current and future development needs, establish a planning culture and introduce strong guiding principles for new development.

The mashrabiya was the inspiration for the design, and the pattern movement was designed to be reminiscent of the mangrove flower (Figure 4.25) opening and closing. Pattern rules, algorithms

and parameters set the concept of generative design, in order to form the required shape and transformation.

Figure 4.25: Mangrove flower
Source: HGTV.com, 2018

One of the main strengths of the Al Bahr façade was its utilization of the parametric modelling in the early design process, to try and optimize the performance of the façade. In the case of Al Bahr Towers, the architectural approach is responsive rather than passive, towards the different changing elements such as wind speeds, angle of incidence and sun exposure throughout the year.

The resulting complex is composed of two towers of 29 floors (Figure 4.26) and can accommodate 1100 employees in each tower.

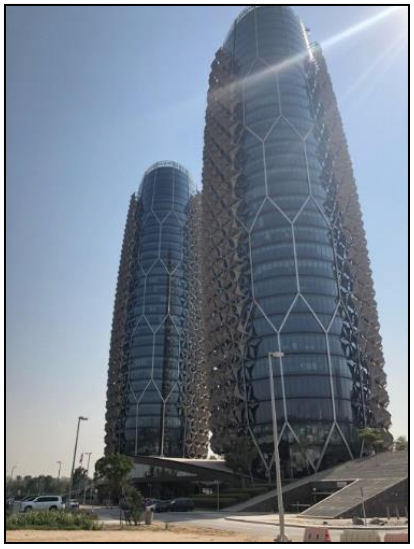

Figure 4.26: Al Bahr Towers

4.3.5 Building Mechanism

The innovative dynamic façade of the Al Bahr Towers is responsive to the movement of the sun, which results in a reduction of solar gain by more than 50%, in which a comfortable internal environment is created for the occupants.
The external façade is composed of 2000 cells, which are integrated with the world's largest computerized façade; opening and closing in response to the sun's movement, helping reduce interior heat. It is more visible at night when the lattice folds and eventually closes.

Through the use of parametric and algorithmic modelling techniques, this approach was facilitated by the use of developed modern technological methods. The design concept was enhanced by pushing the enveloping façade in terms of computing capabilities without compromising the fundamental idea of the project.

A secondary veil (Figure 4.27) comprises intelligent automated shading components that open and close according to the sun's path. The shading veil acts as a dynamic mashrabiya.

Solar heat is reduced by the dynamic screen and distorts the image of the surrounding view. A linear actuator drives the panel that dynamically opens and closes at a frequency of once per day in response to the sequence that is pre-programmed and calculated to prevent direct sunlight from striking the façade and to reduce direct solar gain to a maximum of 400 watts per linear metre.

Figure 4.27: Shading system mashrabiya concept

A variety of sensors protect the entire installation that opens the units when there is an overcast condition or high winds. There is a comprehensive effect of this system: daylight penetration is enhanced, glaring is reduced, artificial lighting dependence is reduced and solar gain is reduced by almost 50%, which leads to carbon dioxide emissions being reduced by 1750 tons per year.

Photovoltaic cells were incorporated onto both south-facing roofs that power the mashrabiya system and makes Al Bahr Towers generate renewably approximately 5% of the total energy required for heating the water.

4.3.6 Heritage Elements of the Al Bahr Towers

The Bahr Tower is one of the most outstanding high-rise buildings that represent the successful implementing of the architectural heritage elements into modern structures.

They have achieved a responsive facade which takes the traditional mashrabiya concept into a developed, modern, computerized structure.

4.3.6.1 The Mashrabiya

The mashrabiya along the east of the building begins to close as the sun rises east of the building, then gradually as the sun moves throughout the day around the building; along the whole vertical strip of the mashrabiya (Figure 4.28).

Figure 4.28: The structure in response to the sun orientation

The mashrabiya and its role in traditional UAE architecture works well here, in the form of the mangrove flower; just a few metres away from its natural habitat. Each mashrabiya cell opens and closes, mirroring the mangrove flower.

Each triangle is coated with fibreglass and programmed to respond to the movement of the sun as a way to reduce solar gain and glare.

4.3.7 CIPP for Case Study 2

Table 4.3: CIPP sample for the case study

CONTEXT	The concept of the building was based on the traditional mashrabiya function of reducing heat gains and glare. A new computerized system idea was established to replace the old heritage wooden lattices.
INPUT	The client considered creating an outstanding modern structure that preserves one of the most important Emirati heritage elements. The design concept of the foreign architects was based on the Emirati traditional architecture.
PROCESS	Developing the traditional mashrabiya into a system that is responsive to the sun movement in order to minimize energy consumption.
PRODUCT	A modern computerized Mashrabiya that prevents unpleasant heat gains and glare into the building. Insufficient amount of light entering the building leading to more use of artificial

	lighting. The shade formed by the external façade creates an unpleasant visual environment for the occupants.

4.3.8 Discussion of Case Study Analysis

The **mashrabiya** of Al Bahr towers were used with a high-technology autonomous responsive system that is sensitive to the amount of solar heat gains and natural lighting.

The mashrabiya was used in a developed method covering the majority of the external façade of the towers. It was used for its **visual** traditional uses of minimizing the unpleasant direct sunlight but it was seen to be enhanced with a computerized system to control the opening and closing of the screens throughout the day, which has led to a significant limitation within the towers. Visibility through the external envelope would compromise for occupants due to the nature of the design (with the exception of the north façade), most particularly when the screens are closed.

While priority is made for solar avoidance against open views, low visibility was actually encouraged in the case of the traditional mashrabiya.

Additionally, the potential inconsistency of the internal lighting created at certain times of the day may prove a source of visual discomfort, particularly with regard to harsh contrasts between the adjacent areas of the working plane, although when part of a double skin, presumably there is less of an issue due to the mashrabiya being some distance from the inner layer; nevertheless the combination of the shadows within the interior space would not be desirable in all instances.

This implies that more artificially tinted lights are required inside as natural light penetrates the interior of the building.

On the other hand, the mashrabiya added an **aesthetic** advance to the facade of the towers, turning them into an outstanding landmark within the city, creating a new aesthetic perspective of the usage of mashrabiyas in contemporary buildings.

From the **thermal** aspect, the computerized mashrabiyas stood as screens preventing extreme levels of solar heat gains which were estimated to be reduced by more than 50%, leading to a reduction in the use of mechanical ventilation, resulting in more energy savings.

Case Study 3

"SHARJAH CENTRAL SOUQ"

Client: Sharjah Municipality (1978)

Figure 4.29: Sharjah Central Souq
Source: Sharjah Municipality,2018

4.4 Introduction

The Central Souq of Sharjah, which is also known as the Souq al-Markazi, is one of the oldest structures within the emirate. Due to its outstanding Islamic architecture, it has been a landmark since 1978. As with other buildings, the Central Souq has been distinguished for its wind towers which used to serve not only as an aesthetic element of its façade but also as ventilation.

4.4.1 History

The Souq was built in 1978, in the Centre of Sharjah. It was the biggest bazaar within the country during that era.

The building is classified with a commercial function for authentic merchants that made it an imperative point for locals and tourists; due to that the building had to have an Islamic aesthetic design that stands corresponding to its use (Figure 4.30).

Figure 4.30: Archival image of the Sharjah central souq
Source: Sharjah Municipality, 1996

20 wind towers were placed within the structure working as ventilation system for the Souq. Later on, the main entrances were covered and the wind towers were shut, leaving them as aesthetic elements neglecting their functionality.

4.4.2 Case Study Details

Completion Date: 1978

Height: 145 m

Stories: 2

Area: 80,000 m^2

Primary Use: Retail shops

Owner/Developer: Sharjah Municipality

Design Architect: Michael Lyle & Partners

Main Contractor: Halcrow International Partnership

4.4.3 Site Location and Accessibility

The buildings are facing the Khalid lagoon from the southwest and Al Ittihad Park from the northeast, having access from three main roads, which are Al Arouba Street (S103), King Faisal Road (S105) and Al Corniche Street (S112) (Figure 4.31).

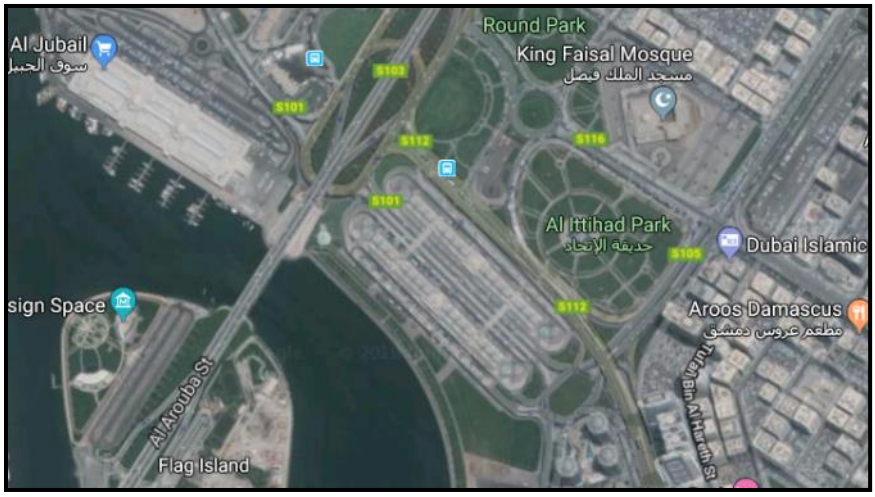

Figure 4.31: The main street accesses to Sharjah central souq
Source: Google Earth

The Souq has outdoor parking lots on the two sides of each building facing the main and service roads (Figure 4.32).

Figure 4.32: The parking lots surrounding the Sharjah central souq

Each building of the Souq has eight entrances (Figure 4.33):

Two main entrances

Three on the side towards the service roads between the buildings

Three on the main roads

Figure 4.33: The entrances to Sharjah central souq

4.4.4 The Design

The Central Souq was designed as a bazaar on a grand scale, in two interconnected two-storey buildings. One has traditional textiles and souvenirs while the second building is a gold market.

The design brief of this building came from His Highness Sheikh Dr Sultan Bin Mohammed Al Qassimi (ruler of Sharjah). The architecture portrays a traditional souq character that has been magnified with Islamic decoration elements in addition to mashrabiyas and wind towers placed over all the buildings (Figure 4.34).

Figure 4.34: The Sharjah central souq
Source: Google Earth

The interior design of the souq has most of the heritage Islamic building elements, such as: ornamentation with Islamic engrained ceramic tiles covering the walls (Figure 4.35), arches, columns and mashrabiyas on the pathway sides (Figure 4.36).

Figure 4.35: The internal wall mashrabiyas

Figure 4.36: The pathways mashrabiyas

The external façade also followed the internal design concept of the building using vault roofs, engrained ceramic tiles, wind towers and mashrabiyas (Figure 4.37).

Figure 4.37: The souq's external façade

4.4.5 Building Mechanism

The souq is passive architecture, integrating architectural heritage elements with contemporary architecture. The wind tower has been identified as one of the architectural heritage elements.

The building used a minimum amount of energy by placing 20 wind towers to ventilate the internal environment, in addition to the steel lattices which were placed on the higher walls of the building, allowing the cool breeze to enter the building and pushing out the warm air through the opened entrances outside the internal envelope.

The mashrabiyas were also used to allow diffused natural lighting into the building, minimizing the artificial lighting required for the end users.

Wind currents are trapped by wind towers and transported towards into interior of the souq. The tower is raised above the building and is governed effectively by the ratio of its width versus its height as an important determinant.

4.4.6 Heritage Elements of the Sharjah Central Souq

The Sharjah Central Souq has used the wind towers and mashrabiyas for their functionality and efficiency in reducing the energy requirements of the buildings, as well as being used for their aesthetic purposes to reflect the emirate's heritage.

4.4.6.1 The Wind Tower

The design of the wind towers of Sharjah Central Souq adheres to the typical design plan of four-directional wind towers; in terms of architectural strategy, this is characterized as one of the most popular types of wind towers due to its four vertical shafts, intersecting one another and separated by partitions in the centre of the wind tower with the purpose of catching wind currents from all directions (Figure 4.38).

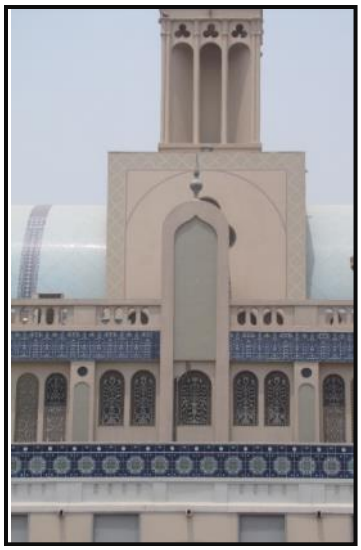

Figure 4.38: The souq's external façade

This particular wind tower has a decoration pattern on the top (Figure 4.39) which is similar to many places within the UAE, such as Al Hisn Fort (Sharjah) (Figure 4.40).

Figure 4.39: The souq's wind tower decoration

Figure 4.40: Al Hisn Fort wind tower decoration
Source: Shurooq development

These wind towers go directly down from the ceiling towards the main alleys of the souq. After the changes in the thermal comfort parameters of the modern retailers, the souq also had to develop to meet the users' comfort therefore the municipality decided to shut the wind towers by covering the outlets with reinforced plastic panels (Figure 4.41).

Figure 4.41: The closed wind tower outlet

4.4.6.2 The Mashrabiya

The **mashrabiyas** were used for both internal and external walls.

On the exterior façade, steel lattices were covering the second-floor arches and allowing cool breeze and natural lighting into the building to fulfill the visual and thermal purposes (Figure 4.42).

Figure 4.42: The external mashrabiya

They were placed on the entrances' structures to assist the side mashrabiyas with the same ventilation and lighting aims (Figure 4.43).

Figure 4.43: The entrance mashrabiyas

The aesthetic aim of the mashrabiyas was seen on the internal pathways of the sides acting as a fence to enhance the heritage design concept of the buildings (Figure 4.44).

Figure 4.44: The internal pathways mashrabiya

The mashrabiyas were covered from the internal side with aluminum-glass windows (Figure 4.45) to prevent the natural ventilation that would run against the mechanical ventilation systems which were installed later but using their visual function in allowing diffused sunlight in (Figure 4.46).

Figure 4.45: The main entrance covered mashrabiya

Figure 4.46: The side entrance mashrabiya

4.4.6.3 The Broken Entrance

The washrooms' entrances were designed with 90^0 angled walls that perform as broken entrances; thus they create more visual privacy for the users and form a barrier blocking those zones from the pathways (Figure 4.47).

Figure 4.47: Women's washroom broken entrance

4.4.7 CIPP for Case Study 3

Table 4.4: CIPP for Sharjah Central Souq

CONTEXT	The building concept was to create a traditional grand bazaar that has heritage elements to emphasize the UAE's historical architecture.
INPUT	The municipality adopted the concept of creating a passive building that minimizes the energy consumption. Foreign designers were selected in order to fulfill the design proposal. Mashrabiyas and wind towers were elected to be the main heritage elements within the souq.
PROCESS	The usage of the traditional mashrabiyas and wind towers for their functionality and aesthetic sight.
PRODUCT	A traditional souq building that resembles the heritage image of the country. Functional heritage elements that serve the needs of end users. A well-designed passive building.

4.4.8 Discussion of Case Study Analysis

The Sharjah Central Souq was a passive building that fulfilled the end users' requirements with minimal energy consumption using the heritage mashrabiyas and wind towers to efficiently ventilate and lighten the inner environment of the buildings (Figure 4.48).

Figure 4.48: The Sharjah Central Souq 1985
Source: Sharjah Municipality

However, with the rapid development of the users' lifestyles, the increasing energy consumption and the thermal comfort factors, the souq had to develop to meet these changes. The higher authorities considered switching the souq into an active building but neglecting the ventilation uses of the wind towers and mashrabiyas, and installed a mechanical ventilation system.

Traditionally the **mashrabiya** was used externally for its **visual** purposes of letting sufficient natural light in to the internal building envelope and enhancing the indoor environment. After covering the mashrabiyas with coloured glass, their functionality remained preserved and they were still supplying the internal environment with some natural light, but it was noticed that the amount of light wasn't efficient to the end users, which led to the necessity of using supporting artificial light sources throughout the day.

From the **aesthetic** aspect, the external mashrabiyas maintained their standing out design before and after their closure, giving the souq an authentic traditional design that stands as a traditional landmark in Sharjah. Whereas the internal mashrabiyas were preserved within the souq without any enhancements to their design, which led to maintaining the souq's internal historical signature.

The mashrabiyas were used for their traditional **thermal** purpose on the external building structure acting as lattices to circulate the airflow within the internal space of the souq this functionality was affected by the glass used to cover the lattices; it blocked the openings which led to neglecting any thermal functionality of the mashrabiya and increasing the mechanical ventilation usage.

The **wind towers** of the souq stood for their **visual** purpose prior to their refurbishment, providing natural light to the internal spaces of the souq which was later on neglected by closing these wind tower outlets, resulting in increasing the artificial lighting dependency.

Whereas the external **aesthetic** appearance of the wind towers preserved their genuine designs even post the renovation, giving the souq its historical characteristics and preserving the heritage element value.

The **thermal** functionality of the wind tower was significant to the end users and energy consumption levels because it directed the natural airflow to the internal zones of the souq during the days prior to their closure. Therefore the shutting of the wind towers outlets caused the dysfunctionality of the element and the neglect of their thermal performance in regard to energy consumption.

The **broken entrance** preserved its functionality within the souq, providing privacy for the facilities that should not be exposed to the public.

As discussed above, the broken entrance is the only element that was unaffected by the building's renovation. The building now stands as an active structure that totally depends on

mechanical ventilation and maximum energy consumption, thus the heritage elements' functionality was abandoned and they stand for their aesthetic uses only (Figure 4.49).

Figure 4.49: The Sharjah Central Souq 2018

Case Study 4

"MASDAR INSTITUTE"

Client: Mubadala Development Company (2006-2015)

Figure 4.50: Masdar Institute
Source: Mubadala Development Company

4.5 Introduction

The Masdar Institute of Science and Technology is a research university for graduate level students whose main focus is sustainability, alternative energy and the environment.

Masdar Institute was established in 2006. The establishment of Masdar Institute is part of a resource diversification policy for the Emirate of Abu Dhabi. Abu Dhabi's leadership views research and education in alternative energy as a keystone for the future development of the emirate.

Underpinning the overall Master Plan was Masdar Institute's commitment towards sustainability through architectural approaches. This was achieved by integrating architectural heritage elements with contemporary, groundbreaking architectural principles.

4.5.1 History

In 2007, construction of the six buildings in Phase 1A began, and was completed and operated by the start of the 2010 academic year. The completion of Phase 1A (Figure 4.54) was an opening of a complex structure that includes laboratories, dormitories, classrooms and faculty offices.

In January of 2011, expansion of the existing campus under Phase 1B (Figure 4.51) started, and was completed by 2012, covering a total area of 86,000 square metres that evolved a second cluster of buildings, which includes more dormitories, a multi-purpose hall with fitness centre, pools, laboratories and administrative offices.

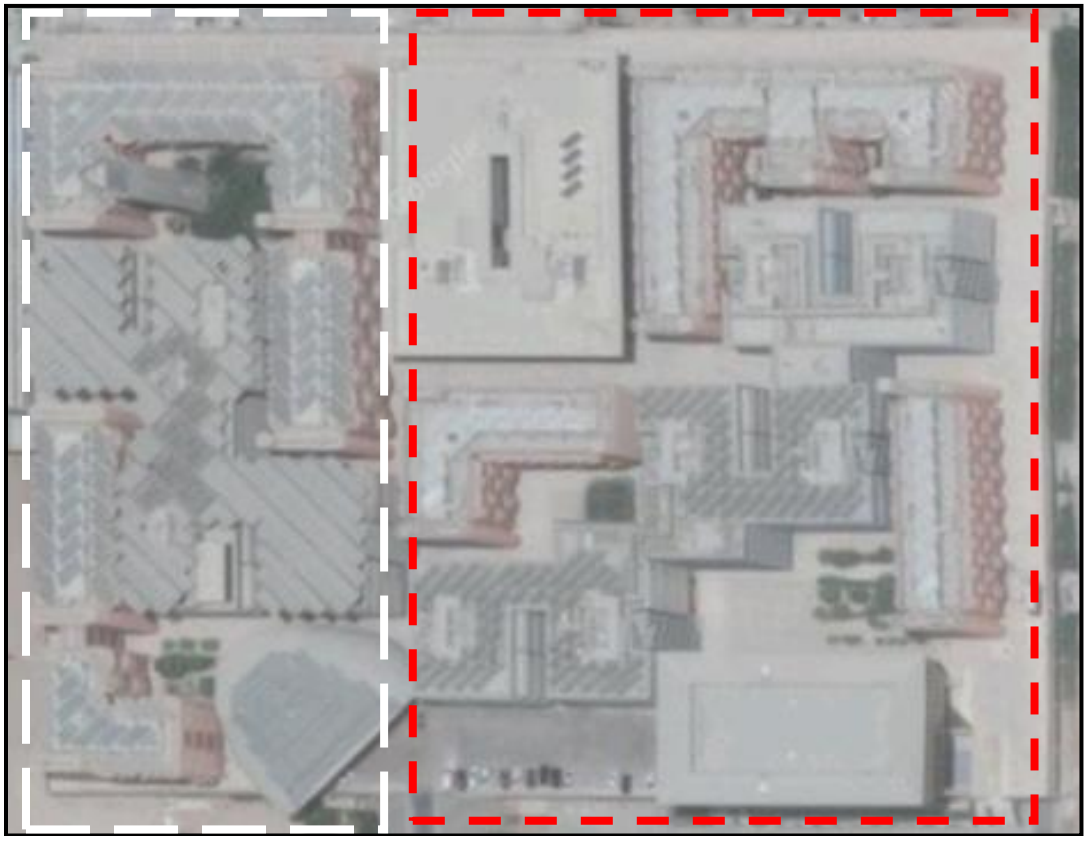

Figure 4.51: White dotted lines: Phase 1A of Masdar institute. Red dotted lines: Phase 1B of Masdar institute.
Source: Google Earth

The Masdar Institute was created in collaboration with the Massachusetts Institute of Technology (Cambridge, USA).

4.5.2 Case Study Details

Architects: Foster + Partners
Structural Engineer: Adams Kara Taylor M+E Engineer: PHA Consult Consultants: Gillespies, Claude Engle
Lighting Design: Acentech, Arup, decarbon8, Lerch Bates, Mott MacDonald, RFD, RW Armstrong, RWDI, Sandy Brown, Systematica, WS Atkins
Area: 4000 m^2
Year: 2012
Client: Mubadala Development Company

4.5.3 Site Location and Accessibility

The Masdar Institute is situated in Masdar City, Abu Dhabi. The Masdar Institute doesn't have any direct access as of now, due to its position in the city and the construction works happening around the institute area.

The Masdar City site is bounded by Khalifa City 'A' to the west, the Airport District to the east and two highways, Dubai-Abu Dhabi Road and Airport Road to the north and south respectively (Figure 4.52).

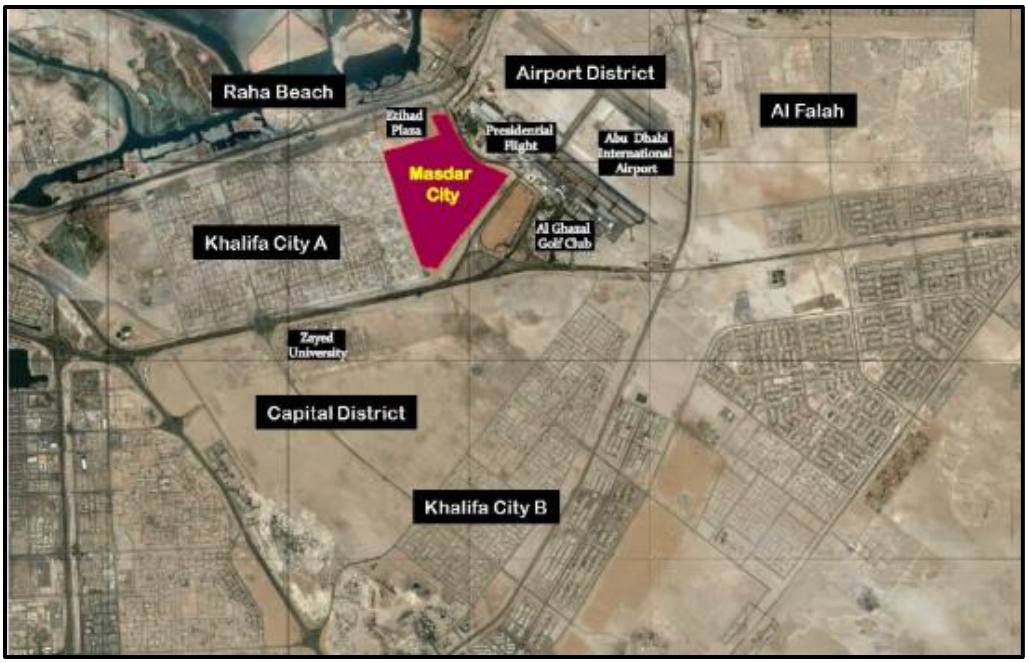

Figure 4.52: Masdar City location
Source: Google Earth

The Masdar Institute has a Personal Rapid Transit (PRT) system currently operational within the undercroft of the Masdar Institute campus (Figure 4.53).

Figure 4.53: Personal Rapid Transit vehicles
Source: Mubadala Development Company

The undercroft is a section that runs underneath the podium of the Masdar Institute campus. The PRT system provides driverless, electric powered vehicles which operate using magnets embedded in the concrete floor every four metres for navigation (Figure 4.54).

Figure 4.54: Undercroft magnet track
Source: Mubadala Development Company

Overhead antennae run along the length of the undercroft to provide a wireless link between the PRTs and the system computer. Currently there are two stops located within the Masdar Institute campus with the potential for future expansion of the route to the IRENA Building (Figure 4.55).

Figure 4.55: Future expansion of the route PRT
Source: Google Earth + Author

4.5.4 The Design

Foster + Partners integrated various innovative passive design strategies in order to achieve this remarkable reduction in cooling demand, most of which were inspired by the heritage elements of the UAE's Arabic and Islamic architecture.

The facades were designed as multiple layers comprising of screen layer/external balcony, insulation layer and inner façade.

The residential accommodation and laboratories are supported by a variety of social spaces. The structures make up the completed section of the institute, as well as an adjacent 86,000 m^2 of housing, laboratory space, and recreational facilities.

The Masdar Institute comprises of laboratories, a Knowledge Centre and student/staff accommodation. The laboratory building is on three floors and located at the centre of the campus.

The residences are on four floors and surround the site, and the Knowledge Centre is a two-storey building situated southwest.

The ground floor contains the main parking area and serves as a podium for the project as well as circulation for both the residential and laboratory flats.

On the first floor, the institute has six main buildings (Incubator Building, Knowledge Centre, Multi-use Hall, Siemens Building, the Wind Tower and Masdar Institute Campus) with corridors, courtyards and open spaces with water features between them (Figure 4.56).

Figure 4.56: Masdar Institute plan guide
Source: Masdar City office

4.5.5 Building Mechanism

Abu Dhabi's Masdar Institute for Science and Technology (MIST) has been a project that solves passive ventilation and lighting. It has provided a local model on how to reduce energy demands and is the first building to be constructed in Masdar City which included a zero-energy target.

Since 2010, MIST's six buildings have achieved a 50% reduction in energy needs, mainly the cooling element, compared with the average UAE building.

The Masdar Institute passive sustainability strategies include:

- Windows that make up less than 40% of exterior wall surfaces
- Well insulated and airtight building envelope helps reduce energy consumption
- Horizontal and vertical shading prevents direct sunlight into buildings
- Fully shaded colonnades reduce direct sunlight on building walls to ensure cooler temperatures
- Stairs are prominently located, while elevators are hidden away to encourage the use of stairs – this is the opposite of what is found in conventional buildings

- Fountains, which flow water over surfaces, rather than spray water in the air, help lower the perceived temperature.

Solar panels and **solar thermal technology** panels cover the roof of the whole building. Many sustainable strategies have been employed such as recycling and renewable energy. The solar panelled roof provides the energy, and currently produces double the energy needs of the building (Figure 4.57).

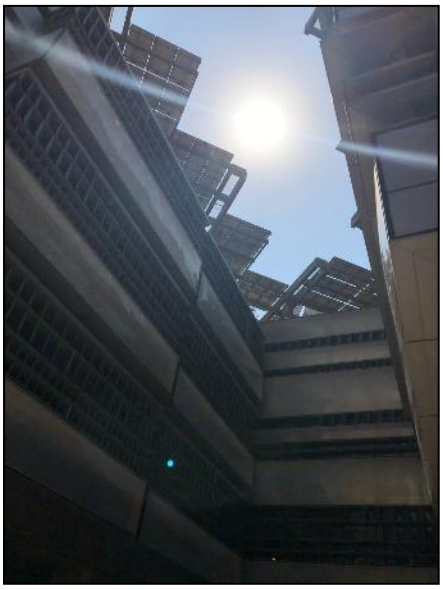

Figure 4.57: Solar panels of Masdar Institute

The solar panels have been instrumental in temperature cooling both inside and outside. Hot water is supplied by thermal technology and covers 250 m^2 on top of the roof area, in addition to its main function as protection and shading the building.

4.5.5.1 Residential Buildings

Masdar Institute's **residential buildings** (Figure 4.58) are defined by the terracotta-coloured, undulating glass-reinforced concrete (GRC) balcony 'screens' that serve much the same role as traditional Arabic mashrabiya screens. They provide shade and privacy, while allowing air to pass through to cool the balconies. Inside, these buildings have a central enclosed atrium that naturally ventilates the common space for much of the year.

Figure 4.58: Residential building's balconies

During the evening, cool air flows from vents opened on the ground level, cooling the interior walls and flowing out through open louvres at the top of the buildings. In warm weather, these openings are closed during the day to keep cool air in. The buildings have solar PV panels on their rooftops to harvest the sun's rays and generate clean, renewable energy. Walls cooled by the night air then provide thermal cooling to keep the interior hallways pleasant throughout the day. The world's first 90% recycled-aluminum sheeting is the same terracotta colour as the GRC screens.

4.5.5.2 Laboratory Buildings

The Masdar Institute **laboratory** buildings are characterized by air-filled ethylene tetrafluoroethylene (ETFE) cushions that limit the heat re-radiated to the street. A reflective foil-clad inner layer behind the cushions sends light to the pedestrian street below. Behind the foil is a highly insulating and highly sealed panel (Figure 4.59).

Figure 4.59: Tetrafluoroethylene cushion on laboratory building

All of Masdar City's buildings advocate wall insulation in addition to strict air-tightness standards with the aim of controlling the infiltration of hot, humid air. Those windows that are not already shaded by adjacent buildings have vertical louvres to block morning and afternoon sun, plus horizontal ones to block midday sun (Figure 4.60).

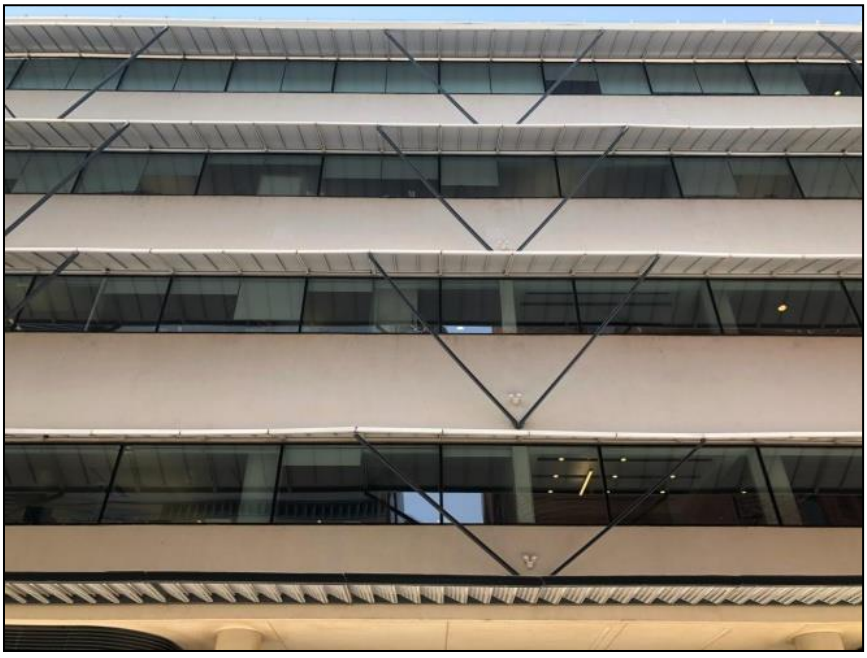

Figure 4.60: Vertical and horizontal louvres

4.5.5.3 Knowledge Centre

The institute's **Knowledge Centre** reflects the designers' efforts to optimize photovoltaic (PV) energy harvesting through the building orientation and the inclination of the PV panels on the roof's curved surface (Figure 4.61).

Figure 4.61: Knowledge Centre

Although the glulam (glued laminated) timber structure is graceful and beautiful, the reason it was chosen over steel was because sustainable timber reduces the building's embodied carbon footprint.

4.5.6 Heritage Elements of the Masdar Institute

The institute is a mixture of high-technology modern and traditionally-designed buildings. The buildings used several heritage elements to meet the requirements of the design concept and sustainability purposes.

Developed mashrabiyas and a wind tower in addition to several courtyards were placed within the institute's external structures.

4.5.6.1 The Mashrabiya

The traditional mashrabiya has developed in several ways within the institute, such as materials, designs and alignments, yet saving its traditional main purposes.

The **residential buildings** glass fibre concrete mashrabiyas stand for visual and thermal purposes. Designed with a wavy envelope to resemble desert dunes that reflect the country's topography, they are coloured with local sand to integrate with the context of the desert and to reduce maintenance.

They create a self-shading façade designed to respond to the orientation and shade the building, as well as the street adjacent to it.

The mashrabiyas provide shading for external balconies of the main residential façade envelope, with functions to deal with the harsh desert environment.

The balcony spaces and vertical mashrabiya screens form the first layer for thermal insulation and were designed to provide efficient thermal comfort for the residents due to the reduction of solar gains in interior spaces (Figure 4.62).

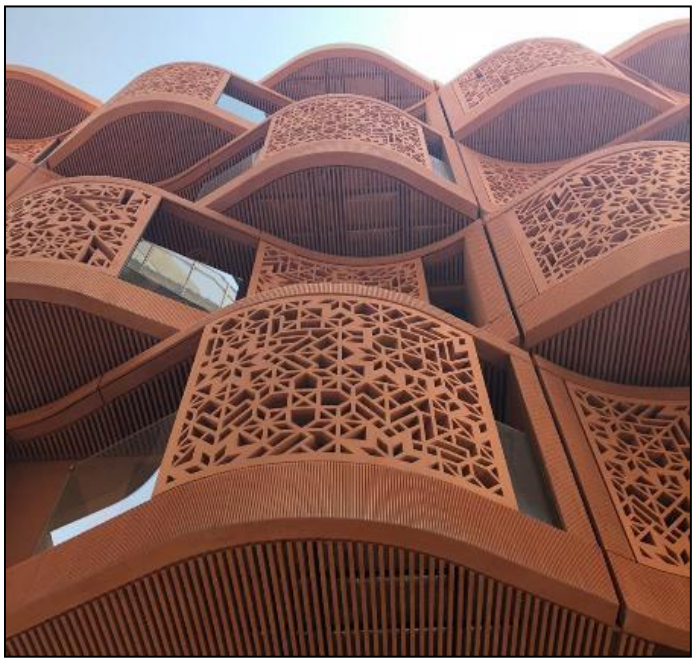

Figure 4.62: Glass fibre concrete mashrabiyas

This was developed using a series of both physical and computational modelling techniques to assist in the determination of the subsequent built form.
The mashrabiyas' patterns were developed to avoid repetition, and their design was inspired by octagonal symmetry with different sizes to create a high level of privacy and visual depth.

The resulting structure is a modern interpretation of the traditional mashrabiya screens, which functions for thermal protection of the second layer of the wall, including windows, as well as creating visually private zones.

The **laboratory buildings** used steel lattices resembling the traditional mashrabiyas' purpose that serves to decrease the solar heat gains into the building.

The steel lattices create an outer layer protecting the aluminum-glass windows beneath, preventing direct sunlight and reducing mechanical ventilation required to create a thermally comfortable space for the users (Figure 4.63).

Figure 4.63: Steel lattices of the reception

The lattices cover the laboratory building reception which stands as a limited area of the overall structure for the purpose of distinguishing the focal point of the institute.

The **Knowledge Centre** roof is a large self-shading projection of folded zinc cladding that is designed inspired by the traditional mashrabiya, controlled by a computerized system responsive to the sun's orientation and weather conditions.

This structure forms a second skin to the main building's façade to decrease the heat gains to the internal environment.

The triangular-shaped openings prevent direct sunlight; however they provide the efficient amount of light to illuminate interior areas (Figure 4.64).

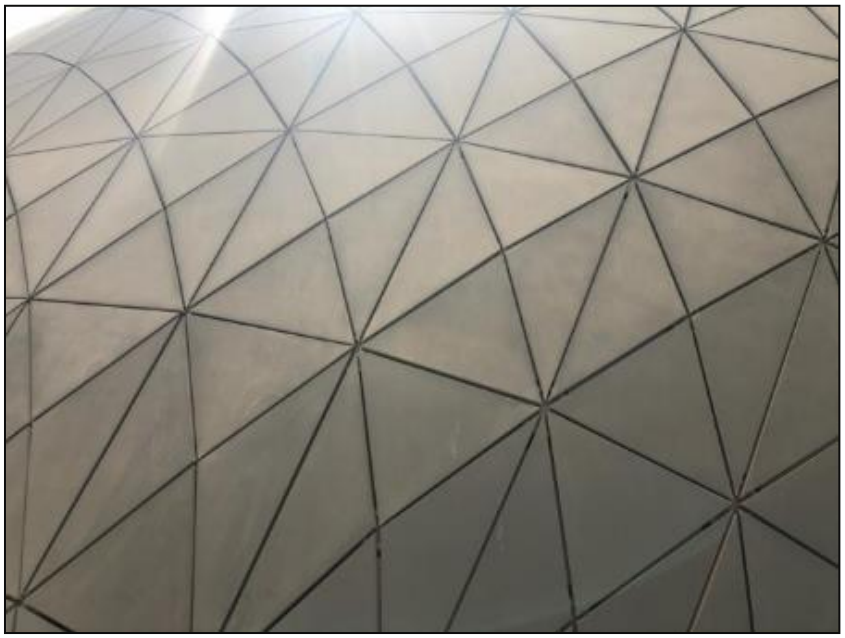

Figure 4.64: Triangular zinc Knowledge Centre roof

The northeast section of the exterior roof extends ventilated shading to the building's entrance and nearby public spaces.

The mashrabiyas in Masdar Institute have been placed in **several locations** around the campus, considering its efficient functionality with providing natural ventilation, shading and controlling the heat gains.

Steel lattices were placed on the edges of the swimming pool (multi-use hall) to control the direct sunlight and create more privacy for users from outsiders (Figure 4.65).

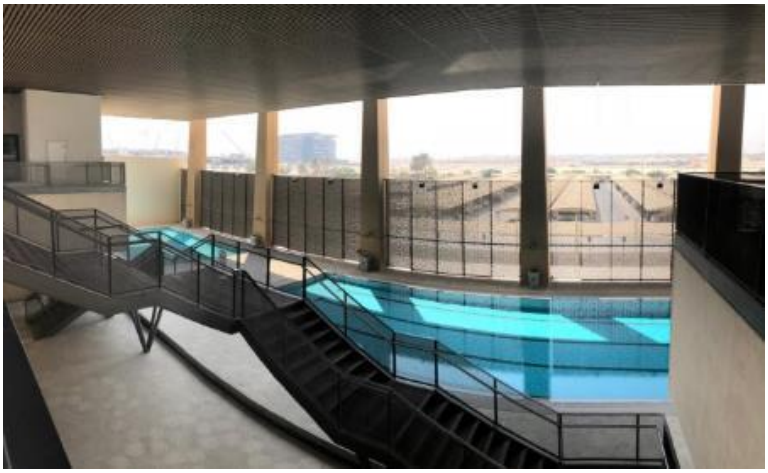

Figure 4.65: The steel mashrabiya of the swimming pool

On numerous glass claddings a lack of shading was witnessed; wooden lattices were installed as a second façade, preventing exposure to unwelcomed glimpses as well as decreasing glare within the work/study zones (Figure 4.66).

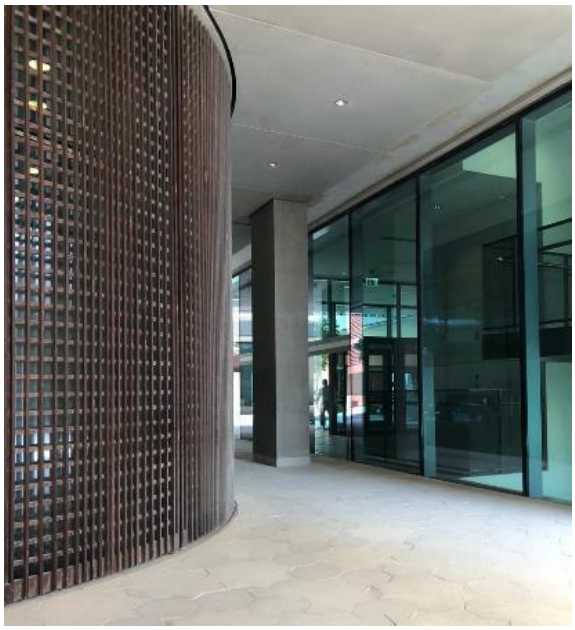

Figure 4.66: Wooden mashrabiyas on glass claddings

Vertical perforated wooden screens were placed on the narrower pathways of the first floor for wind-trapping purposes, to circulate the natural air around the campus. The screens are movable on an in-ground embedded steel rail (Figure 4.67).

Figure 4.67: Movable vertical wooden screens

4.5.6.2 The Wind Tower

The most notable element in the Masdar Institute campus is the 45m-tall wind tower, supplying a cool breeze downward towards the central courtyard (Figure 4.68).

Figure 4.68: The wind tower of Masdar Institute

This reinterprets the traditional wind towers which have some degree of opening. This wind tower is equipped with modern sensors that will operate its top louvres to open in the direction of the current prevailing winds, thus ensuring maximum efficiency.

Mist generators are placed at the top of the wind tower, reducing the air temperatures. The air is carried downwards using a non-stick membrane.

The wind tower is a platform for the scientific instruments – including weather measuring equipment and air quality testing tools – that improve personal comfort within the campus depending on the Masdar Institute combinations of evaporative cooling and air movement techniques.

The wind tower was placed at the centre of the main courtyard partly due to its heritage factor, as well as its essential role in bringing ventilation to the building.

4.5.6.3 The Courtyard

The campus has been surrounded by multiple courtyards spread around the buildings, generating focal points and outdoor social areas (Figure 4.69).

Figure 4.69: Several courtyard locations (indicated by stars)

The courtyards create comfortable external environments used by students, employees and staff members to gather for meetings, relaxation and discussions (Figure 4.70).

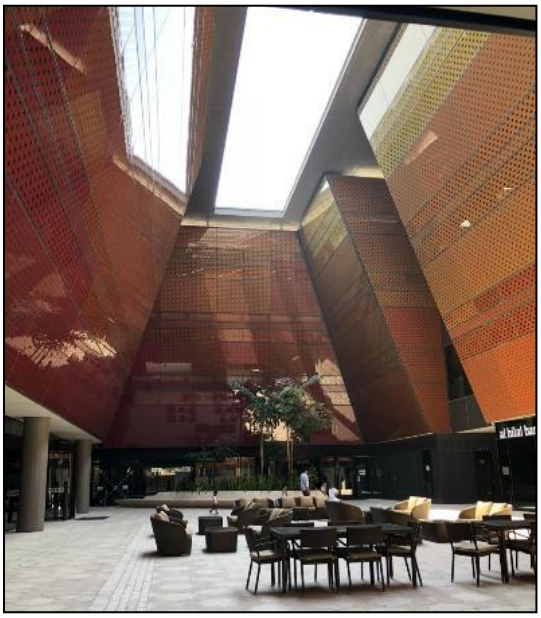

Figure 4.70: Incubator building courtyard

Plants and water elements were placed around the courtyards to provide a cooler air flow circulating, to enhance the thermal comfort requirements for the users (Figure 4.71).

Figure 4.71: Plants and water elements within the courtyard

Solar panels and surrounding buildings provided the required shading to minimize the direct sunlight and heat.

4.5.7 CIPP for Masdar Institute

Table 4.5: CIPP for Masdar Institute

CONTEXT	Creating a sustainable city that runs sufficiently on renewable energy and reducing the overall environmental footprint. Using the heritage elements' function to support the sustainable concept of the building.
INPUT	Importing highly developed technologies and a qualified foreign team to fulfill the design concept. Emphasizing the concept of using a high-density built area. Considering the low-rise construction techniques. Building a research institute that sufficiently runs on renewable energy and occupied with students with sustainability-related interests and fields. Modern and traditional building designs to avoid repetition and build an outstanding landmark.
PROCESS	Pedestrian-friendly mixed-use development implemented within the campus buildings. Using the heritage elements traditional functions. Developing new mechanisms and computerized systems to run the modern building structures. Achieving sustainability during every stage of constructing the institute to ensure the reduction of the carbon footprint.
PRODUCT	Efficiently functioning heritage elements fulfilling the thermal comfort standards for the institute. Well-developed techniques assembling the traditional/modern concept of the buildings. Thermally comfortable building envelopes and efficiently lighted environments. An outstanding application that stands out in the international sustainability studies.

4.5.8 Discussion of Case Study Analysis

Masdar City in general and the Masdar Institute in particular were designed and built generally using techniques and developed technologies in order to minimize and conserve energy, thereby reducing the carbon footprint (Figure 4.72).

Figure 4.72: Aerial view of Masdar Institute
Source: Masdar City Head Office

Sustainability was the priority the institute was constructed for, achieving zero carbon dioxide emissions in order to create an environmentally friendly city that stands as a landmark and a functional model for the future plans of developing the city of Abu Dhabi in particular, and the entire country in general.

High installation building materials, developed shading devices and techniques, high-density built area, narrow alleys/pathways, renewable energy resources and traditional developed heritage elements were the key factors supporting the efficiency of the project.

Heritage building elements stand as the most used building elements within the whole built institute's envelope, proving their functionality and ensuring their efficiency when it comes to sustainability and energy-conserving structures.

The developed **mashrabiyas** were controlled by a computerized system to ensure their highest **visual** efficiency of providing natural light to the internal zones without overheating. This made them perform their maximized functionality conveying the rapid users' thermal comfort changes. The traditional mashrabiyas within the institute were also positioned in places where their functionality is preserved and maximized, preventing unpleasant glare and direct solar light.

The **thermal** functionality of the developed and traditional mashrabiyas was also preserved, keeping the mashrabiyas as lattices to block the direct sunlight from the internal zones of the institute's buildings, thereby minimizing the need for mechanical ventilation and resulting in more energy savings.

Aesthetically, the developed mashrabiyas created a distinguished building, with the panels giving the building a shell structure that is responsive to sunlight. The traditional mashrabiyas also contributed to the design concept of the institute, combining traditional heritage elements within contemporary buildings and preserving their functionality during harsh weather conditions.

The **wind tower** of Masdar Institute fulfilled its **thermal** functionality by a computer-controlled system that evaluates the volume of airflow and responds accordingly by operating the shutters opening and closing to circulate air within the courtyard surrounding the wind tower and creating a pleasant outdoor atmosphere.

The **courtyards** in this case study preserved their traditional **thermal** functionality of creating a pleasant outdoor breeze by circulating the airflow around and providing shaded outdoor areas to fulfill the users' thermal comfort. They developed to being social hubs where people gather in a comfortable outdoor atmosphere that beats the harsh weather conditions.

4.6 Comparative Analysis of the Case Studies

The comparative analysis exercise which will be used on the analyzed case studies is a tool to help reach further understanding and pinpoint the advantages and disadvantages of each case study, that will assist with generating more reliable information and more relevant results to the methods used (CIPP).

The four heritage elements discussed in the examined case studies will be analytically compared to measure their functionality in the following parameters:

- Visual
- Aesthetic
- Thermal

The mashrabiya is the most used element within the four different case studies, and works with traditional and developed methods, however performing the traditional mashrabiya functions and purposes.

The comparative analysis for the mashrabiya element will depend on its visual, thermal and aesthetic aspects as well as their developed and traditional usage.

The tables below are established based on the discussion of the case studies to generate reliable information for evaluating the functionality of the mashrabiya within the four cases.

Table 4.6: Comparing traditional mashrabiya within case studies 1&3

	Abu Dhabi Central Market (case study 1)	**Central Souq Sharjah (case study 3)**
Location	On internal walls, ceilings and pathways sides	External façade, internal walls and pathways sides
Similarities	The usage of the traditional lattices that resembles the mashrabiya	
Purpose	Visual, thermal and aesthetic	
Functionality	Functions for visual and aesthetic purposes, however not fulfilling the thermal aspect	Functions for visual and aesthetic purposes; the thermal aspect got neglected after covering the openings

Table 4.7: Comparing the developed mashrabiya within case studies 2&4

	Al Bahr Towers (case study 2)	**Masdar Institute (case study 4)**
Location	On the external structure creating a double-skinned façade	On the external structure of the Knowledge Centre creating a double-skinned façade
Similarities	Modified mashrabiya lattices that are controlled by computerized system	
Purpose	Reducing heat gains, preventing direct sunlight and proving shade	
Functionality	Functions as an efficient shading system that reduces the need for mechanical ventilation	

Table 4.8: Comparing the traditional and developed mashrabiyas within the four case studies

	Abu Dhabi Central Market & Central Souq Sharjah	**Al Bahr Towers & Masdar Institute**
Process	Traditional mashrabiya lattices	Computerized insulation layer influenced by mashrabiya lattices
Product	A traditional mashrabiya implemented in a modern building that is partially fulfilling the focal aims of its function	Contemporary buildings with modified computerized mashrabiya structures functioning efficiently to achieve the required purposes of placing these structures

The second most-used element witnessed is the wind tower. Traditional and developed wind towers were used in two of the case studies. They were mainly used for their traditional function of enhancing the thermal comfort and reducing the air temperature of the surroundings.

The traditional wind tower functioned in Sharjah Central Souq, however it stands as an aesthetic element within the structure due to the refurbishment that has happened which led to neglecting its functionality. The refurbishment wrecked the aim of placing the wind towers as well as disregarding its thermal role for the building.

The developed wind tower is placed in Masdar City and is controlled by a computerized system that adjusts to the weather conditions, and the need of using the wind tower within the campus to minimize the energy consumed to operate it.

This wind tower has become an iconic landmark that sets standards for developed wind towers locally and internationally.

Table 4.9: Wind tower comparative analysis for case studies 3&4

	Central Souq Sharjah (case study 3)	**Masdar Institute (case study 4)**
Location	20 wind towers placed within the building's structure in several locations	Single wind tower positioned in the central courtyard
Similarities /differences	Traditional wind tower	Developed computer-controlled wind tower
Purpose	Thermal comfort	
Functionality	Neglecting the thermal usage of the wind tower after shutting off its louvres, leaving it standing as a traditional wind tower of no use, yet keeping an antique impression for the building	A functional wind tower that sufficiently works to bring the cool breeze into the courtyard

Table 4.10: Courtyard comparative analysis for case studies 1&4

	Abu Dhabi Central Market (case study 1)	**Masdar Institute (case study 4)**
Location	The mall / the souq	Several locations around the campus
Similarities /differences	Indoor courtyards	Outdoor courtyards
Purpose	Social active areas and providing natural light	Air circulation and social hubs
Functionality	The mall courtyard does not fulfill the requirements of any of the purposes, whereas the souq courtyard consummates the needed purposes of providing diffused natural light and creating a lively occupied area in the centre of the souq	The courtyards are executed with water elements and plants to support the thermal intent of implementing the courtyards between the buildings, and the pleasant outdoor cool breeze create socially active focal points within the campus

The location of courtyards seen in the case studies was inspired by the traditional placing within the Abu Dhabi Central Market, whereas in the Masdar Institute they were placed outdoors between the campus's buildings to achieve the requirements of their placement.

The courtyards were used for their traditional function of thermal comfort and developed to being used as a social hub that gathers people around the focal point within the environment it is placed at, due to which it increases the importance of the area surrounding it.

The Abu Dhabi Central Market succeeded in achieving the developed social aim of the courtyard in the souq building, as it is positioned between the most popular shops and restaurants, therefore fulfilling the above-mentioned advantages.

On the other hand, the courtyard within the mall building was positioned in an area where it did not function as required because of its location, lack of lighting and retailers.

Table 4.11: Broken entrance comparative analysis for case studies 1&3

	Abu Dhabi Central Market (case study 1)	**Central Souq Sharjah (case study 3)**
Location	Towards washroom and prayer rooms entrances	
Similarities /differences	Used the traditional concept of a broken entrance	
Purpose	Achieved high social privacy levels for end users (particularly women)	
Functionality	The broken entrances at the mentioned locations provide privacy for users and prohibit intruders	

The Masdar Institute used developed outdoor courtyards that were positioned between the buildings instead of being traditionally located within the structure of the building.

The courtyards in the Masdar Institute used the traditional purpose of creating a thermally comfortable area. The pleasant outdoor environment led to developing the purpose of the courtyard to become a social hub.

The broken entrances seen in the Abu Dhabi Central Market and Central Souq Sharjah are inspired by the concept of the traditional broken entrance of providing privacy.

The traditional broken entrances were always positioned in house entrances to block the unpleasant views from people walking across the alleys when the doors are opened, whereas in the two mentioned case studies the broken entrances use the same concept but positioned in different locations due to the requirements of their users and the need for privacy in such public

buildings. They were placed at the prayer rooms and washrooms to create a barrier between the users of these facilities and the walkers around the souq.

The comparative analysis tables established above organized the outcomes of the case studies analysis to generate deeper understanding and increase awareness in regard to the functionality of each element in each case study, as well as comparing the implementation of these elements and evaluating their degree of suitability in contemporary buildings in order to further consider them in future projects.

4.7 CIPP Method Validity

The CIPP was used as the main method to analyze the examined case studies. It has proven its validity in generating reliable data throughout the analysis process due to its subdivisions which segregate the four processes each building goes through from the design stage until completion, which are as follows: Context, Input, Process and Product.

The four diversions force the researcher into further investigations and understanding the case study, thereby creating a solid database that stands as a pillar for the analysis.

The CIPP method could be developed further in order to meet the researcher's purpose of using this specific method.

4.8 Revised Conceptual Framework

After analyzing the outcomes of the case studies and the comparative analysis, the initial conceptual framework produced in Chapter Three for each element of each case study has been developed to contain more accurate and valid data to sum the results of examining the case studies, which were to evaluate the impact of implementing the heritage elements in contemporary buildings of the United Arab Emirates (

Table 4.12, Table 4.13, Table 4.14 &
Table 4.15).

Table 4.12: Revised conceptual framework for Abu Dhabi central market heritage elements

INVESTIGATION ASPECTS					
		Efficiency	F/NF	Implementation	T/D
ABU DHABI CENTRAL MARKET HERITAGE ELEMENTS	MASHRABIYA	VISUAL	NF	VISUAL	D
		THERMAL	F	THERMAL	D
		AESTHETIC	F	AESTHETIC	D
	WIND TOWER	VISUAL	-	VISUAL	-
		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	COURTYARD	VISUAL	NF	VISUAL	D
		THERMAL	F	THERMAL	D
		AESTHETIC	F	AESTHETIC	D

	BROKEN ENTRANCE	VISUAL (PRIVACY)	F	VISUAL (PRIVACY)	T

Table 4.13: Revised conceptual framework for Al Bahr Towers heritage elements

INVESTIGATION ASPECTS					
		Efficiency	F/NF	Implementation	T/D
AL BAHR TOWERS HERITAGE ELEMENTS	MASHRABIYA	VISUAL	F	VISUAL	D
		THERMAL	F	THERMAL	D
		AESTHETIC	-	AESTHETIC	-
	WIND TOWER	VISUAL	-	VISUAL	-
		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	COURT YARD	VISUAL	-	VISUAL	-

		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	BROKEN ENTRANCE	VISUAL (PRIVACY)	-	VISUAL (PRIVACY)	-

Table 4.14: Revised conceptual framework for Sharjah Central Souq heritage elements

INVESTIGATION ASPECTS					
		Efficiency	F/NF	Implementation	T/D
SHARJAH CENTRAL SOUQ HERITAGE ELEMENTS	MASHRABIYA	VISUAL	NF	VISUAL	T
		THERMAL	NF	THERMAL	T
		AESTHETIC	F	AESTHETIC	T
	WIND TOWER	VISUAL	NF	VISUAL	T
		THERMAL	NF	THERMAL	T
		AESTHETIC	F	AESTHETIC	T
	COURTYARD	VISUAL	-	VISUAL	-

		THERMAL	-	THERMAL	-
		AESTHETIC	-	AESTHETIC	-
	BROKEN ENTRANCE	VISUAL (PRIVACY)	F	VISUAL (PRIVACY)	T

Table 4.15: Revised conceptual framework for Masdar Institute heritage elements

INVESTIGATION ASPECTS					
		Efficiency	F/NF	Implementation	T/D
MASDAR INSTITUTE HERITAGE ELEMENTS	MASHRABIYA	VISUAL	F	VISUAL	D
		THERMAL	F	THERMAL	D
		AESTHETIC	F	AESTHETIC	D
	WIND TOWER	VISUAL	-	VISUAL	D
		THERMAL	F	THERMAL	D
		AESTHETIC	NF	AESTHETIC	D

	COURTYARD	VISUAL	-	VISUAL	T
		THERMAL	F	THERMAL	T
		AESTHETIC	F	AESTHETIC	T
	BROKEN ENTRANCE	VISUAL (PRIVACY)	-	VISUAL (PRIVACY)	-

4.9 Summary

This chapter analyzed the heritage elements implemented within the chosen four case studies which were either used for their traditional uses or developed to fulfill the requirements and needs of the new era's modern construction technologies and techniques, as well as stating their advantages and disadvantages.

The elements have proven their functionality in some case studies in both their developed method and the traditional purposes and mechanisms; on the other hand, some elements were used for aesthetic purposes, only neglecting their input and functionality in the modern developed buildings.

The **mashrabiya** with its traditional and developed techniques was positioned in several locations of the four cases. Visual, thermal and aesthetic were the three focal aims of using the mashrabiya within the structures, indoors, and on the external facades.

Developed and traditional **wind towers** were found in two of the case studies, mainly used for thermal purposes, circulating air and minimizing the mechanical ventilation required to cool the internal and external zones.

The external and internal **courtyards** were witnessed in two of the case studies. Traditional indoor and developed outdoor courtyards were used to accomplish the thermal and social aims of placing them between buildings/retailers, connecting alleys and around water elements/plants to circulate cool breeze and create focal gathering points for people to socialize.

The **broken entrance**, which is the least noticed element by users and researchers was positioned in two case studies in the entrances of the private/facility areas within the public retail areas to achieve the privacy demanded for social needs.

This chapter also finalized the conceptual framework with reliable outcomes to the comparative analysis data obtained, and verified the imposition of "case study" methodology in generating data to compare the heritage elements.

The four discussed and analyzed elements proved that with the right designing and planning processes they would function efficiently and meet the requirements of modern structures.

Chapter 5
Conclusions and Recommendations

5.1 Introduction

This chapter is to summarize the outcomes of the previous chapters in this research in order to establish a set of recommendations to the contributors, and directly influence that would enhance the regulations and studies in the preservation of the heritage elements of the country.

This research fulfilled the main purpose of investigating and analyzing the interventions that have happened to the implementation of the heritage elements in contemporary buildings in the United Arab Emirates, as well as achieving the objectives it was established for, which are as follows:

- Identification of heritage elements in Emirati architecture and how they are integrated, which was addressed with the first question of the first chapter and fulfilled by the **Defining The Historical Origins Of Architectural Elements** chapter, which explained

the Emirati heritage elements in depth and the way they were functionally integrated into the traditional buildings, and the factors that affected their efficiency while implementing them in contemporary buildings.

- To analyze the traditional heritage elements within the contemporary buildings in terms of their functionality, developed techniques validity, thermal performance and social sustainability. This was supported by question number two of chapter one; the **Defining The Historical Origins Of Architectural Elements** chapter demonstrated the heritage elements of the UAE and the **Case Studies Discussions** chapter analyzed the functionality of implementing the developed/traditional heritage elements in contemporary case studies to generate a comparison that expresses the designs' weaknesses and enhancing approaches.

- To design a conceptual framework that integrates architectural heritage elements with contemporary architectural designs and construction developments. This was addressed by the third question of the first chapter; the **Planning the Research Methodology, Philosophy and Framework** chapter comprised the initial conceptual framework that evaluated the researcher's degree of understanding in regard to the functionality and characteristics of the Emirati heritage elements, and the **Case Studies Discussions** chapter enhanced the initial conceptual framework to generate a final conceptual framework that is more accurate and reliable to the discussion of the comparative analyses done on the discussed case studies.

- To determine the advantages and disadvantages of using the heritage elements within the contemporary buildings. That has been expressed by the fourth question of the first chapter. The **Case Studies Discussions** chapter debated the advantages and disadvantages of implementing the heritage elements in contemporary buildings and what affected their efficiency in each case study, in order to generate sufficient comparison for better analysis and understanding.

- To formulate a set of recommendations and guidelines to improve the implementation of architectural heritage elements in the UAE. This was connected with the content of question five in chapter one. The **Conclusions and Recommendations** chapter stated the set of recommendations to be followed by the concerned organizations and individuals in order to overcome the voids in the system of preserving the Emirati heritage elements and achieve their maximum efficiency.

5.2 Conclusion

The UAE's architecture has been greatly influenced by the influx of socio-economic activity. In the period where global civilization, including the Middle Eastern region, cannot forego the compelling role of technological advancement in the area of construction and design that threatens the role of heritage elements of architecture in the contemporary buildings of the UAE, this is not the complete reality where a few radical designs prove that heritage elements are still relevant and applicable in the modern age.

The challenge among planners, architects and designers of urban fabrics is therefore to analyze and choose designs in which aspects of heritage are incorporated towards structures – relationships that are functional and are determined by the social needs, environmental requirements and economic aspects that are understood in contemporary design.

With the increasing interest in heritage elements and the need to educate the current generation of the UAE, the preservation of the culture becomes more important and challenging in order to save the architectural identity of the country.

The researcher was able to explore the core element of heritage architecture of the UAE. The main and underlying factor towards the traditional architecture of the UAE is determined by the modifying ambient environment that objects protect the occupants from external factors that cause undesirable habitation.

The mixture of nationalities that has varying cultural motivations led to the evolution of the traditional architecture of the country. Some elements that were added to the local concepts in order to define its style and character were developed to cope with the demands of the society.

The case studies had demonstrated that even at the time when technology has a cutting edge in building design, the concepts of the architectural heritage elements still stands to be relevant and significant.

In this research, it was identified that the architectural heritage elements of the UAE are as follows:

- The mashrabiya which serves as a barrier that prevents the direct sunlight from the exterior of the building towards the inside spaces and reduces solar gains, while it allows cool breezes to enter when the lattices are not covered.

- The wind towers that allow the capture of faster, cooler and higher breezes than the ground level air which are warm and hot. The air that is being caught inside the wind tower is directed downwards towards users' zones while the resulting vacuum inside the tower drives away the warm air from the lower levels.

- The courtyards which are central spaces, built usually at the center of the building and which direct cooler air to stay within the area. These spaces are coupled with water elements when placed outdoors, as well as green plants to make the habitable spaces cooler. This allows the creation of social hubs for users on the other hand.

By achieving the maximum efficiency of the mashrabiya, wind tower and courtyard, they would noticeably contribute to the country's energy savings. By using more natural ventilation, minimizing direct sunlight, blocking solar heat gains and circulating cool breezes within the internal and external spaces, the mechanical ventilation energy consumption would reduce, resulting in more benefits to the country, owners and end users, in addition to the aesthetic role

of these elements which support the preservation purpose of protecting the identity of the UAE's architecture.

- Broken entrances, that are 90-degree L-shaped walls that stand as a barrier which keeps intruders from private areas and facilities, were traditionally used on the entrances of houses where they block the outsiders' views from the internal zones; on the other hand, the concept has developed to being used in washrooms, administration offices and facilities of public buildings.

The broken entrance is an eminent element which conserved its authenticity during the contemporary era; it proved its validity and functionality when used as a privacy element to fulfill the inhabitants' needs and cultural values. In contemporary buildings it stood for its traditional function and served the required purpose in several places rather than the traditional location it was used at (as mentioned previously in Chapter 2).

After choosing the right methods to choose the case studies followed by deep understanding of the methodologies used to analyze and criticize the case studies, it was found that placing the right elements within the structures in order to achieve the maximum efficiency is possible in several ways; however, it requires solid baseline and enough knowledge of the buildings' requirements to understand which element should be positioned where.

This research had established that there can be two main approaches towards the interpretation of architectural heritage elements in the contemporary times:

- Passive architecture: this is a strategy of architectural design where passive cooling is the prevailing inspiration and motivation of the building design and is aimed at the attainment of a natural and sustaining indoor environment that is cooler than the outside environment. This reduces the dependence on energy-intensive mechanical cooling, which saves capital expenditure, reduces energy costs, and improves indoor air quality. This has been demonstrated by four case studies in this research.

- Responsive architecture: this can be equally applied as a strategy and approach towards interpreting architectural heritage elements in contemporary building design. The strength of this approach is its versatility, which can be applied to any type and scale of structure. One of the most popular ways of attaining responsive architecture is through façade design, though it is not limited in this manner, such as the Al Bahr Towers where the façade had been responsive towards environmental change.

5.3 Limitation of the Research

- Sample size: The numbers of case studies which have reliable information to the scope of this research are limited due to the low efficiency elements placed within the buildings in the UAE, which resulted in limiting the number of cases examined.

- Lack of available and/or reliable data: This research depends on the modern buildings to be analyzed as well as some newly introduced approaches; therefore it makes it hard to reach data from previous researches that could match the scope of the research.

- Self-reported data: This research relies on the researcher's perspective when criticizing the case studies, which results in the limitation of referencing the information provided within the research's body.

- Access: The number of case studies was limited to four, due to the long duration process for legal approvals to access some confidential government buildings such as the Federal Courts Complex of Abu Dhabi.

- Cultural bias: The research's region of scope was the UAE, which limited the number of case studies; this is due to the need to enrich the information of the heritage elements addressed to the UAE.

5.4 Contribution to Knowledge

The fundamental purpose of this researcher is to relook at the concept of heritage elements from a modern perspective.

By far the majority of the heritage elements-oriented studies have focused on the comparison between traditional and contemporary buildings which have heritage elements implemented within their design, whereas this research compares the reliability and functionality of the heritage elements when addressed in contemporary buildings.

The outcomes of comparing the case studies validate the implementation of heritage elements within contemporary buildings and the following contributions are established within this study:

- This research provides a conceptual framework for the discussion of implementing the heritage elements within the contemporary buildings.

- It raises the problem of the misuse of the elements which should be considered in the future design concepts and constructed buildings, as well as providing important recommendations to be followed to avoid creating the same misconception.

- It provides a practical model for the CIPP method as well as an opportunity for future researches to expand the diversions of the method to achieve more reliable data in comparing contemporary developed buildings.

- It provides guidelines for the application of the heritage elements in a traditional and developed approach.

- It provides a discussion of the broken entrance concept that has been practised on accomplishing privacy purposes for several facilities while neglecting the direct connection of the concept with the broken entrance element.

- It addresses the privacy concept achieved by the broken entrance.

5.5 Recommendations

This set of recommendations is divided into three segments of society (the local community, architect and designers, and finally the government) to develop enhanced architectural practices that form the integrated urban fabric within the community.

5.5.1 General Recommendations

Social architectural and heritage awareness stands at a very important position when the implementation of heritage elements within contemporary buildings is to be accomplished.

The public and future generations should be aware of the following guidelines:

- Understand the local heritage elements, their functionality and their possible developments that perform in the modern era.

- Increase the awareness of the added benefits and the energy savings achieved within the buildings by using the heritage elements.

- Adopting the idea of cultural richness and the local identity value to preserve the UAE's heritage during the rapid development in addition to the mixture of cultures within the country.

- Achieving an archaeological awareness and enhancing the knowledge of its direct connection to the locals' pride and unique identity to stand out among other cultures.

5.5.2 Recommendations for Architect and Designers

A huge portion of the responsibility to implement the heritage elements within the contemporary buildings in an efficient manner relies on the architects and designers who start the initial stages of the building process.

Some recommendations are set below for the designing teams in order to successfully implement the heritage elements:

- Study the design requirements and the suitable orientation of the heritage element at the initial design stage.

- Consider the funds of the project to make the decision of placing either traditional heritage elements or developed computerized elements to meet the requirements as well as the budget.

- Understand whether the client requires the heritage elements for aesthetic use or for their function, to minimize mechanical ventilation and artificial lights within the structure.

- The exaggeration of placing the elements doesn't necessarily mean more functionality, whereas placing sufficient numbers at the right positions guarantees better performance.

- Increase the aesthetic value of the heritage element by enriching the connection of the element with the surrounding environment.

- Avoid foreign architectural identity influence which doesn't function in the weather conditions of the country and affects the building's performance, as well as neglecting the heritage architectural styles of the Emirati buildings.

- Filter the foreign concepts in order to use the appropriate developed designs which suit the country's climate and culture to enhance the functionality of the heritage elements.

- Identify the uses of heritage elements in proportion to their functions and understand their distinction and interpretation.

- Increase the possibility of developing and changing the form of the heritage element while preserving its functions, aesthetics and authenticity.

5.5.3 Recommendations for Decision-makers (Government)

At the risk of losing the UAE's architectural heritage, it will be necessary to have a policy of preservation; not only with our historic buildings, but guidelines for new projects to include and integrate architectural cultural features. This generation of Emiratis has an obligation to look after its architectural heritage.

Therefore below are some recommendations for the decision-makers and government associations to take into consideration:

- It is essential that the Federal government of the UAE establishes a specialist non-profit institution to create, adopt and administer a legislative framework for the preservation of heritage elements. This institution would have a purpose of enhancing and testing the knowledge of developing and implementing the heritage architectural elements in contemporary buildings.

- Establishing an engineering course that educates the preservation standards and regulations as well as developing heritage element techniques to pursue in contemporary buildings.

- To cooperate with professional societies which are concerned with architectural preservation techniques that are suitable for the implementation of such principles into the country's building regulations.

- Create and issue special building regulations to limit the use of heritage elements randomly.

- Establish policies and standards that should be implied to support the preservation of heritage elements such as building material and colour.

- Increase the locals' interest in the heritage elements by involving them in determining the procedures of preservation and make the appropriate decisions regarding the efficient ways of saving these elements' values and identities from degradation.

- Work on the inventory and documentation of heritage elements and use that in a database that aims to increase awareness of the cultural heritage values.

- Develop a strategy to support investment in heritage elements and make them economically useful to minimize energy consumption.

- Ecologists should be involved when planning to use heritage elements in contemporary projects to ensure construction of more eco-friendly buildings.

- Sociologists should be involved to consider social requirements in contemporary projects.

5.5.4 Recommendation for Proposed Future Researches

Research into a specific topic does not stop after one or two papers; it requires continuous researches to cover different perspectives and angles to the problem discussed from the research findings and limitations.

Hereby are some proposed recommendations for future scholars who are interested in the scope of this research:

- Expand the region from which the case studies are chosen, to avoid the limitation of the number of cases to be examined, therefore generating more data to run a more detailed comparison.

- Understand in depth the problem to be discussed, in order to choose appropriate case studies that have a rich data archive.

- Identify the scope of the research at the initial stages of forming the structure to minimize the conflicts during the progress.

- For refurbished buildings, the CIPP method could be enhanced by adding more subdivisions to explain the development procedure and the final product after the process is done (this is for preexisting traditional buildings which have been though the development phase).

- Generate researches that understand in depth the traditional building materials and compare it with modern building materials, as well as explain the impact of the modern building materials on the environment.

- Explore more case studies for the heritage elements which are not given enough of a value during this era, such as the broken entrance which has been used as a concept but is not connected to the actual heritage element purpose.

References

Abdul Kader, B. (2019). Mohammad: Terrorism a threat to cultural heritage. [Online]

Abdel-Gawad, A. (2012). Veiling architecture. Cairo: American University in Cairo Press.

Abdul Kader, B. (2016). Mohammad: Terrorism a threat to cultural heritage. [Online] Gulfnews.com. Available at: https://gulfnews.com/entertainment/arts-culture/mohammad-terrorism-a-threat-to-cultural-heritage-1.1939354.

Abudhabi.ae. (2018). [Online] Available at: https://www.abudhabi.ae/portal/public/en/citizens/culture-and-recreation/cultural-and-historical-sites/sheikh-zayed-grand-mosque.

Abedi, M. and Soltanzadeh, H. (2014). The Interaction between Tradition and Modernity in Contemporary Architecture of Persian Gulf States: Case Study of United Arab Emirates. *International Journal of Research in Humanities and Social Studies*, 1(1).

Alchetron.com. (2018). Sharjah – Alchetron. The Free Social Encyclopedia. [Online] Available at: https://alchetron.com/Sharjah.

Al Abed and Hellyer, 2001: United Arab Emirates: A New Perspective.

Al-Abed, Ibrahim & Hellyer, Peter (2001) United Arab Emirates: a New Perspective, Trident Press Ltd, UK

Al-Mansouri, Mohammed & Al-Naim, Mushary (2005) Modern Architecture in UAE: A Study to Early Transformation in City before Declaration of the Federation, Architectural & Planning Journal, Vol.16.

Al-Zubaidi, Maha (2002 June) the Efficiency of Thermal Performance of the Desert Buildings, 30th Annual Conference of Canadian Society of Civil Engineers, 5-8 June,Montreal, Canada.

Aljofi, E. (2005). The potentiality of reflected sunlight through Rawshan screens.

Ardalan, N. (1993): Innovation and Traditions: New design's relevance to Cultural Heritage, Archaeology and the Arts in the United Arab Emirates, Arts & Islamic World, Special Issue (23), Islamic Arts Foundation London, UK.

Anderson, Graham (1995) Sharjah, U.A.E.: The Urban Conservation Dilemma, Information & Culture Institute, 1st Ed, Sharjah Government, UAE www.sdci.gov.ae

Bahadori, M. (1978). Passive Cooling Systems in Iranian Architecture.

Bahnassi, A. (2003). al-'Imārah. al-Shāriqah: Dā'irat al-Thaqāfah wa-al-I'lām.

Bahnassi, A. and Haddad, L. (2003). The Islamic architecture and its specificities in teaching curricula. Rabat: Islamic Educational, Scientific and Cultural Organization-(ISESCO).

Benkari-Boudidah, N. (2013). L'architecture des mosquées Ibadites au M'Zab, Djerba et Oman Tome I. Saarbrücken: Presses Académiques Francophones.

Briggs, A. (1974). Social thought and social action. Westport, Conn.: Greenwood Press.

Briggs, M. (1974). Muhammadan architecture in Egypt and Palestine. New York: Da Capo Press

Bryman, A. (1974). Analyzing qualitative data.

Bukhash, R. (2010). Heritage architecture. [Online] Construction Week Online Middle East. Available at: http://www.constructionweekonline.com/article-10540-heritage-architecture.

Bukhash, Rashad, 2000: Managing Restoration Projects in Dubai - United Arab Emirates

Campbell, S. (1996). Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development.

Cantacuzino and Browne, 1977:Isfahan.Architectural Review.

CAMRE (2005 June) Sustainable Building & Construction in the Arab Region, League of Arab States, Egypt

Corbin, J. and Strauss, A. (1990). Grounded Theory Research: Procedures, Canons, and Evaluative Criteria.

Cook, J. (2000). Passive cooling. Cambridge, Mass.: MIT Press.

Construction Week Online Middle East. (2019). The UAE's heritage architecture must be preserved. [Online] Available at: https://www.constructionweekonline.com/article-47269-the-uaes-heritage-architecture-must-be-preserved.

Crabtree, B. and Miller, W. (1999). Doing qualitative research. Thousand Oaks, Calif.: Sage Publications.

Critchlow, K. (1999). Islamic patterns. Rochester, Vt.

Davies, D. and Dodd, J. (2002). Qualitative research and the question of rigor.

De La Cerna, F. (2017). The UAE's heritage architecture must be preserved. [Online] Construction Week Online Middle East. Available at: https://www.constructionweekonline.com/article-47269-the-uaes-heritage-architecture-must-be-preserved.

Dihnavī, M. (2001). Qalamzanī bih rivāyat-i Maḥmūd Dihnavī =. Tihrān: Khānah-i Farhang va Hunar-i Gūyā.

Drucker,P.(1986). The Changed World Economy. Foreign Affairs,64.

Dubai Municipality, 2004: The Organization of Islamic Capitals and Cities Award 2004 for City Beautification and Landscaping Project in Dubai

Embaby, M. (2014). Heritage conservation and architectural education: “An educational methodology for design studios”. HBRC Journal

Eisner, E. (1991). The Enlightened Eye. Toronto.

Eisenhardt, K. (1989). Building Theories from Case Study Research. Academy of Management.

Fathy, H., Shearer, W., & Sulṭān, ‘. (1986). Natural energy and vernacular architecture. Chicago: Published for United Nations University by University of Chicago Press.

Fiankan-Bokonga, C. (2017). A historic resolution to protect cultural heritage. [Online] UNESCO. Available at: https://en.unesco.org/courier/2017-october-december/historic-resolution-protect-cultural-heritage

El Amrousi, M., & Shakour, S. (2013). Sustainable Architecture In Rapidly Developing Gulf Cities: A Search For Identity. Atiner Conference Paper Series (Pp. 5-16). Athens: Athens Institute For Education

Freeman, E. (2010). General sketch of history. [Place of publication not identified]: Nabu Press.

Ghaemmaghami, P. and Mahmoudi, M. (2005). Wind tower a natural cooling system in Iranian traditional architecture. In: International Conference “Passive and Low Energy Cooling 71 for the Built Environment. [Online] Santorini, Greece. Available at: http://www.inive.org/members_area/medias/pdf/Inive/palenc/2005/Ghaemmaghami.pdf.

Gulfnews.com. Available at: https://gulfnews.com/entertainment/arts-culture/mohammad-terrorism-a-threat-to-cultural-heritage-1.1939354

Gerring, J. (2007). Case study research. New York: Cambridge University Press.

Gilbert, N. (2001). Researching Social Life.

Gillham, B. (2010). Case Study Research Methods. 1st edition.

Glaser, B. and Strauss, A. (1967). Discovery of Grounded Theory.

Guba, E. and Lincoln, Y. (1985). Effective Evaluation: Improving the Usefulness of Evaluation Results Through Responsive and Naturalistic Approaches. The Journal of Higher Education.

Ghanem, S. (1992). Industrialization in the United Arab Emirates. Avebury.

Guide.theemiratesnetwork.com. (2018). Location of the United Arab Emirates [UAE] on the World Map - TEN Guide. [Online] Available at: http://guide.theemiratesnetwork.com/maps/uae_world.php.

Hakim, C. (1987). Research design: strategies and choices in the design of social research.

Hantrais, L. (1995). Social policy in the European Union. Houndmills: Macmillan Press.

Hart, R. and Pichler, A. (2015). A new look at humanism.

Hawker, R. (2008). Traditional Architecture of the Arabian Gulf: Building on Desert Tides. WIT Press / Computational Mechanics.

Heard-Bey, F. (2004). From Trucial States to United Arab Emirates. Dubai: Motivate.

Healy, M. and Perry, C. (2000). Comprehensive Criteria to Judge Validity and Reliability of Qualitative Research within the Realism Paradigm.

Heard-Bey, Frauke (1982). From Trucial States to United Arab Emirates, Longman London, UK.(2006) the Columbia Electronic Encyclopedia, 6th ed. Columbia University Press, USA.

Heritage21.com.au. (2019). [Online] Available at: https://www.heritage21.com.au

H Montazeri, F Montazeri, R Azizian, S Mostafavi (2010) Two-sided wind catcher performance evaluation using experimental, numerical and analytical modeling, Renewable Energy 35 (7), 1424-1435

Historicengland.org.uk. (2017). Historic England - Championing England's heritage | Historic England. [Online] Available at: https://historicengland.org.uk/.

Hoaglin, D., Klema, V. and Peters, S. (1982). Exploratory Data Analysis in a Study of the Performance of Nonlinear Optimization Routines. ACM Transactions on Mathematical Software.

Icomos.org. (2011). European Charter of the Architectural Heritage - 1975 - International Council on Monuments and Sites. [Online] Available at: https://www.icomos.org/en/charters-and-texts/179-articles-en-francais/ressources/charters-and-standards/170-european-charter-of-the-architectural-heritage.

Johnson, R. (1997). Examining the validity structure of qualitative research.

Johansson, R. (2003). Case Study Methodology. [Online] Available at: http://www.psyking.net/htmlobj-3839/case_study_methodology-_rolf_johansson_ver_2.pdf.

Kakiuchi, E. (2017). Cultural heritage protection system in Japan: Current issues and prospects for the future. Gdańskie Studia Azji Wschodniej.

Karim, Luiza (1999, Sep.) Modernity and Tradition in Dubai Architecture, Al-Shindagah, Available on www.alshindagah.com/september99/architecture.html

Kay, Shirley (1989) Land of the Emirates, Motivate Publishing, Dubai, UAE.

Katodrytis, G. and Mitchell, K. (2015). UAE and the Gulf: Architecture and Urbanism Now.

Kenzari, B., & Elsheshtawy, Y. (2003). The Ambiguous Veil: On Transparency, the Mashrabiy'ya, and Architecture. Journal Of Architectural Education.

Koch-Nielsen, H. (2002). Stay cool. London, UK: James & James

Koch, E. (2014). [Rezension von:] Monumental matters: the power, subjectivity, and space of India's Mughal architecture.

Louw, H. (1983). Architectural History. The Origin of the Sash-Window.

Mahgoub, M. (1997). Reinforced concrete column retrofit using steel jackets.

Maitra, J. and Ḥajjī, ‘. (2001). Qasr Al Hosn. Abu Dhabi, UAE: Centre for Documentation and Research.

Maudlin, D. (2010). Crossing Boundaries: Revisiting the Thresholds of Vernacular Architecture. Vernacular Architecture.

Miles, M. and Huberman, A. (1994). Qualitative data analysis. Thousand Oaks, California: Sage.

Miles, M. (1979). Qualitative Data as an Attractive Nuisance: The Problem of Analysis. Administrative Science Quarterly.

Mohamed, J. (2015). The traditional arts and crafts of turnery or mashrabiya.

Morgan, G. and Smircich, L. (1980). The Case for Qualitative Research. The Academy of Management Review.

Mapio.net. (2016). Baynunah Tower. [Online] Available at: http://mapio.net/pic/p-2838258/.

Mahmoudi, M., 2007. Wind Catcher: The Symbol of Iranian Architecture. Yazda Publications, Tehran.

Meir I.A., D. Pearlmutter & Y. Etzion (1995), on the microclimatic behavior of two semi-enclosed attached courtyards in a hot dry region, Building and Environment.

MCQUEENEY, K. (2012). Dubai before the boom: Staggering pictures show how emirate went from desert backwater to the Manhattan of the Middle East in just 50 years. [Online] Mail Online. Available at: http://www.dailymail.co.uk/news/article-2144613/Pictures-Dubai-1960s-1970s-city-fishing-settlement.html.

Memarian G. and Brown F. (2004). The shared characteristics of Iranian and Arab courtyard house, Edwards B. et al. (eds.), Courtyard housing: past, present and future, Taylor & Francis, Abingdon, Oxon.

Matsushita, Kazuyuki (1980) New Dubai Municipal Building, Japan Architect, Vol. 55

Nasr, S. (1997). Evolution of structural patterns on surfaces. London, ON: Faculty of Graduate Studies, University of Western Ontario.

Nasr, S. (1997). Islamic art and spirituality. Lahore: Suhail Academy.

Nermine Abdel Gelil Mohamed (2006)A New Mashrabiyya for Contemporary Cairo: Integrating Traditional Latticework from Islamic and Japanese Cultures ,Journal of Asian Architecture and Building Engineering 5(1):37-44

Oweis, F. (2002). Islamic Art as an Educational Tool about the Teaching of Islam. Art Education.

Ouf, Ahmed M. (2000) Urban Conservation Concepts for The New Millennium in the United Arab Emirates, Zayed Center for Heritage and History, Al-Ain, UAE.

Park, J. and Abdelkader, R. (2018). Spatial Principles of Traditional Cairene Courtyard Houses in Cairo.

Patton, M. (1990). Designing Qualitative Studies. Qualitative evaluation and research methods.

Patton, M. (2001). Qualitative Research & Evaluation Methods.

Pathak, S. (2012). Dubai aims to protect 220 historic buildings by 2016. [Online] Gulfnews.com.

Available at: http://gulfnews.com/news/uae/culture/dubai-aims-to-protect-220-historic-buildings-by-2016-1.1008142.

Pendlebury, J. (2009). Conservation in the age of consensus. London: Routledge

Petruccioli A. (2004), the courtyard house: typological variations over space and time, Edwards.

Rashid. Noor M, 2004: *Castles & Forts in the United Arab Emirates*, Cultural Foundation,Abu Dhabi, UAE.

Reid, J., Hartog, H., Nelson, W. and Kern, B. (2000). Law as culture and culture as law. Madison, Wis.: Madison House Publishers.

Ragin, C. (1989). The comparative method.

Sarana, G. (1975). The methodology of anthropological comparisons. New York: Wenner-Gren Foundations for Anthropological Research.

Safarzadeh H. and Bahadori M.N. (2005), Passive cooling effects of courtyards, Building and Environment.

Searle, J. (1995). The construction of social reality. London: Penguin.

Seale, C. (1999). Quality in Qualitative Research.

Seale, M. (2012). The Use of Peppermint Oil to Reduce the Nausea of the Palliative Care and Hospice Patient.

Schramm, W. and Mayo, J. (1971). Notes on case studies of instructional media projects. Washington, D.C.: Eric Document Reproduction Service.

Stake, R. E. (1995). The art of case study research. Thousand Oaks, CA: Sage.

Stenbacka, C. (2001). Qualitative research requires quality concepts of its own.

Stake, R.E. (1994). Case Studies, in N.K. Denzin and Y. Lincoln (Eds). Handbook of Qualitative Research. California: Sage Publications

Solaripedia.com. (2010). Solaripedia | Green Architecture & Building | Projects in Green Architecture & Building. [Online] Available at: http://www.solaripedia.com/13/205/2084/wind_tower_dubai_details.html.

Tang, A., Han, J. and Chen, P. (2004). A comparative analysis of architecture frameworks

Thomas, R. (2003). Blending qualitative & quantitative research methods in theses and dissertations. Thousand Oaks, Calif.: Corwin Press.

The Columbia Electronic Encyclopedia, 2006: History of the United Arab Emirates

UNESCO. (2019). A historic resolution to protect cultural heritage. [Online] Available at: https://en.unesco.org/courier/2017-october-december/historic-resolution-protect-cultural-heritage.

Veldpaus, L. (2015). Historic urban landscapes: framing the integration of urban and heritage planning in multilevel governance. Technische Universiteit Eindhoven.

Yin, R. (1984). Case study research.

Yin, R. (2012). Applications of case study research. London: SAGE.

Yin, R. K. (2003). Case study research: Design and methods (3rd Ed.). Thousand Oaks, CA: Sage

Yellowpages-uae.com. (2015). Heritage Elements in UAE on Yellow Pages, UAE. [Online] Available at: https://www.yellowpages-uae.com/uae/heritage-elemets.

Zahla, Rosemarie Said (1989) the Making of the Modern Gulf States: Kuwait Bahrain, Qatar,The United Arab Emirates and Oman, Unwin Hyman Ltd, UK.

Zandy, Daruish (1993), Development of Architecture in the Gulf, in Kay.

Zarghami, J. and Olfat, M. (2005). The Role of Sustainable Fractal Geometry in Islamic Architecture and Revitalizing the Roots of it in Contemporary Architecture. Journal of Social Issues & Humanities.

Focus Group Questions

1. How reliable is the title of this research in regard to the current state or art in the United Arab Emirates?

2. Does the flow of topics of this research deliver appropriate understanding to the readers?

3. Do you know what you are expected to know and be able to do at the end of this research?

4. What are the current problems the Emirati heritage elements are facing during the rapid development of the country?

5. Do the methodologies used function a solid framework to run the research and generate valuable data? If not, what are the suggestions to be implemented to improve the methodology?

6. What are the suggested limitations for this research?

7. Are the four chosen case studies appropriate to fulfill the objectives and title of this research?

8. What suggestions could be given to designers to improve the situation of the heritage elements' integration in contemporary buildings?

Observation List for Case Studies

1. What heritage elements are implemented in the building?
2. How many of each element has been addressed in the case study?
3. How many buildings does the case study contain?
4. Were the heritage elements implemented used in their traditional or developed manner? If developed, how were they developed?
5. What was the purpose of placing the elements?
6. Are the elements placed in an appropriate location?
7. What materials were used to construct the elements?
8. How efficient was each element in the locations they were placed in?
9. What are the suggestions to improve the functionality of the elements?
10. Did the elements enhance the overall building structure?
11. How did the elements address the Emirati heritage?
12. What aesthetic rule did the element fulfill in the building in regard to the end users?

To Whom It May Concern

Wednesday

13th of June 2018

Address: Sharjah Municipality - Architectural Heritage Department

Subject: Request for Documents

Dear all,

I would like to request the following documents for my PhD studies, as the Sharjah Central Souq is a case study chosen for my research (The Impact of Implementing Heritage Elements in Contemporary Buildings in the UAE) that will be submitted to the University of Wolverhampton, UK.

The documents required are as follows:

- Old building plans
- The plan after the refurbishment
- Old pictures of the souq
- Any other relevant documents that could assist the study

Kindly advise who is the concerned person to contact in order to follow the process of receiving the above-mentioned required documents.

Sincerely,

Shaikha Khuloud Al Qassemi

To Whom It May Concern

Wednesday

4th of June 2018

Address: Abu Dhabi Municipality

Subject: Request for Documents

Dear all,

I would like to request the following documents for my PhD studies, as the Al Bahr Towers and The Abu Dhabi Central Market are case studies chosen for my research (The Impact of Implementing Heritage Elements in Contemporary Buildings in the UAE) that will be submitted to the University of Wolverhampton, UK.

The documents required are as follows:

- Old building plans (if applicable)
- The recent plans of the buildings
- Archival pictures (if applicable)
- Any other relevant documents that could assist the study

Kindly advise who is the concerned person to contact in order to follow the process of receiving the above-mentioned required documents.

Sincerely,

Shaikha Khuloud Al Qassemi